THE AMERICAN VEGETABLE-SHORTENING INDUSTRY: ITS ORIGIN AND DEVELOPMENT

FATS AND OILS STUDIES
OF THE
FOOD RESEARCH INSTITUTE

No. 1. *The Fats and Oils: A General View*
[February 1928]

No. 2. *Copra and Coconut Oil*
[April 1928]

No. 3. *Inedible Animal Fats in the United States: Considered with Special Reference to Sources of Animal Waste, the Rendering Industry, Municipal Reduction, and Some Effects of Meat Inspection*
[December 1929]

No. 4. *Margarine as a Butter Substitute*
[December 1930]

No. 5. *The American Vegetable-Shortening Industry: Its Origin and Development*
[June 1934]

For Institute publications, address

FOOD RESEARCH INSTITUTE
STANFORD UNIVERSITY, CALIFORNIA

EUROPEAN SALES AGENTS

Great Britain: P. S. King & Son, Ltd., Orchard House, 14, Great Smith Stree
Westminster, S.W. 1, London

Continental Europe: Martinus Nijhoff, 9 Lange Voorhout, The Hague, Hollanc

FATS AND OILS STUDIES
No. 5 June 1934

THE AMERICAN VEGETABLE-SHORTENING INDUSTRY

Its Origin and Development

By

G. M. WEBER
Formerly Research Associate, Food Research Institute

and

C. L. ALSBERG
Director, Food Research Institute

STANFORD UNIVERSITY PRESS

FOOD RESEARCH INSTITUTE
STANFORD UNIVERSITY, CALIFORNIA

THE FOOD RESEARCH INSTITUTE

was established at Stanford University, California, in 1921, jointly by the Carnegie Corporation of New York and the Trustees of the Leland Stanford Junior University, for research in the production, distribution, and consumption of food.

DIRECTORS

Printed in the United States of America
By Stanford University Press

PREFACE

This book endeavors to trace the economic history of an important and peculiarly American industry. Since the evolution of most industries is largely influenced by technological developments and by inventions, the authors have sought to perform their task with full consideration of these factors. The body of the text has, however, been kept free from technological discussions in order not to break the thread of continuity of the economic treatment. Technological aspects have, so far as possible, been relegated to the appendices. These appendices will interest chemists rather than economists. A glossary of terms, with brief descriptions of the raw materials of the industry, their sources and their principal uses, is presented in Appendix A. Technological and scientific material has been concentrated in Appendices B and C. Most of the statistical material used is concentrated in Appendix F, in tables convenient for reference.

The historical approach has been followed, partly because it seemed the most satisfactory method to place present conditions before the reader, but partly, also, because the history of this industry presents an interesting chapter in the development of industry and technology in the United States.

The authors found information concerning the compound industry both in its early and in its later stages of growth to be widely scattered. For certain periods and on certain points, pertinent information is fragmentary and its reliability unverifiable.

A few of the outstanding men identified with the industry in its infancy are still living. So far as possible, these men were consulted in order to help clarify the be-

ginnings and early life of the industry. Old files of trade journals, notably the *Oil, Paint, and Drug Reporter* and patent and trade-mark literature were relied on heavily.

Some effort was made to obtain records of the activities of the organizations dominant in the industry during the early years, but due to the many changes, these records unfortunately have been largely destroyed.

However, in spite of these various limitations, it is hoped that this volume may prove of interest to those who are, or have been, identified with the industry, as well as to students of American industrial history.

The writers wish to acknowledge their indebtedness to the following men who gave liberally of their time: Mr. W. B. Allbright, Dr. David Wesson, Mr. Henry G. Eckstein, Mr. James Boyce, Mr. Wallace E. McCaw, Mr. T. O. Asbury, Dr. E. E. Chandler, Mr. G. G. Fox, Dr. W. D. Richardson, Professor N. R. Whitney, Mr. J. F. Rogers, Mr. R. F. Crow, Dr. R. H. Kerr, Mr. Louis N. Geldert, Mr. George H. Bennett, Mr. Earl S. Haines, Mr. George S. Templeton.

The writers are most indebted to Dr. J. S. Davis, for his critical analysis of every detail of the work, and for his many valuable suggestions. They are especially indebted to R. F. Lundy for assistance in dealing with statistical materials. Other staff members whose assistance the writers wish to acknowledge are Ruth Lee Young, Rosamond Peirce, who aided materially with the tables and statistical computations, and P. S. King for the preparation of the charts.

CONTENTS

CHAPTER PAGE

I. HISTORY OF THE INDUSTRY UP TO 1890 1

The subject—The use of fats for cooking and shortening—Origin of the industry in America—Influence of the margarine industry—Rise of the cottonseed-oil industry—Influence of technical improvements in cottonseed-oil production—Disappearance of independent lard refiners—Early patents for compound—Trade-marked compounds and lard substitutes—Emergence of the new industry

II. EARLY ATTEMPTS TO CONTROL COMPOUND BY LEGISLATION 34

Widespread food adulteration—The McGeogh case and its aftermath—Early efforts toward state and federal legislation—British prosecution of misbranding—Federal investigations of adulteration—Renewed demands for legislation, 1889–90—Other food-control bills—Final efforts to secure federal legislation, 1892–93

III. THE INDUSTRY FROM 1890 TO THE WORLD WAR . 59

Reasons for paucity of data—Indications of the course of production—Price influences in the 'nineties—Trademark and patent developments in the industry—Principal domestic outlets for compound—Factors affecting expansion around and after 1900—Position of cottonseed-oil producers in the cooking-fat industry—The rôle of the packers in the industry up to 1914—Volume of output under federal inspection—Economic effects of hydrogenation—Growing independence of compound—Export trade in compound cooking fat—Summary

IV. WAR-TIME AND POST-WAR DEVELOPMENTS, 1914–32 106

Volume of output—War-time developments—Post-war boom and depression—Types of compound now produced—Raw materials—Production by classes of manufacturers—Production by class of product—Production costs—Ownership concentration and geographical distribution of production—Present export trade in compound—The tariff and compound

CHAPTER PAGE

V. INTERRELATIONSHIPS OF PRODUCTION, CONSUMPTION, AND PRICES 168

Factors in production variation—Seasonal variations: Production, consumption, and prices—Per capita consumption of lard and compound—Household as compared with commercial consumption—Price relationships—The effect of compound on the demand for lard—Packers' efforts to strengthen lard markets

VI. THE COMPOUND INDUSTRY AND THE NATIONAL ECONOMY 213

CHARTS

CHART PAGE

1. Cottonseed Oil Production, Exports, and Domestic Retention, 1874–75 to 1889–90 14
2. Wholesale Prices of Lard and Cottonseed Oil, Spreads between Them, and Index of Business Activity, Monthly, 1876–90 17
3. Cottonseed Oil Production, and Aspegren Estimates of Domestic Uses, 1889–90 to 1904–05 64
4. Wholesale Prices of Lard and Cottonseed Oil 1890–1904, of Oleostearin 1892–1904, and of Compound 1897–1904; Price Spread between Lard and Cottonseed Oil; and Index of Business Activity, Monthly, 1890–1904 68
5. Wholesale Prices of Lard, Cottonseed Oil, Oleostearin, and Compound; Price Spread between Lard and Cottonseed Oil; and Index of Business Activity, Monthly, 1904–18 92
6. Exports and Export Prices of Lard and Compound, 1888–89 to 1913–14 99
7. Compound Exports to Principal Destinations, 1896–97 to 1917–18 100
8. Exports of Lard and Compound to Europe, to West Indies, and to Mexico and Central America, 1900–01 to 1925 102
9. Compound Production, 1908–32, According to Available Data and Estimates 107

CHART PAGE

10. Exports and Average Export Prices of Lard and Compound, Annually, 1908–09 to 1932 109

11. Wholesale Prices of Lard, Cottonseed Oil, Oleostearin, and Compound; Price Spread between Lard and Cottonseed Oil; and Index of Business Activity, Monthly, 1918–32 113

12. Fats and Oils (Other than Cottonseed Oil) Used in Manufacture of Compound, 1912–23 118

13. Course of Production of Cottonseed Oil and Compound, 1922–31 169

14. Lard Production, Exports, and Domestic Retention, 1900–32 171

15. Spreads of Compound and Cottonseed Oil Prices from Lard Prices, and Prices of Compound and Cottonseed Oil as Percentages of Lard Prices, Based on Annual Average Prices Available from 1875 to 1932 . 172

16. Spread between Prices of Lard and Cottonseed Oil, and Production of Compound, 1922–32 180

17. Seasonal Indexes of Lard, Compound, and Cottonseed Oil Production, 1922–32 181

18. Factory Production of Lard and Compound, Quarterly, 1922–33, with Trends 182

19. Estimated Per Capita Consumption of Butter, Lard, Compound, and Margarine, 1900–33 186

APPENDIX

APPENDIX PAGE

A. Glossary 223

B. The History of the Technology of the Compound Industry 232

Introduction—The production of hard fats—The production of illuminating oils—The refining of oils—Bleaching oil—Deodorizing oils—Early forms of compound in Europe—Early progress in the manufacture of compound in the United States—Hydrogenation

APPENDIX PAGE

C. METHOD OF ACTION OF SHORTENINGS 275

Introduction—Shortening—Method of action of shortening—Correlation of flour quality and shortening effect—The effect of shortening upon the leavening process—Effect of shortening on the onset of staleness—The measurement of shortening power—Choice of shortening

D. TRADE-MARKS OF COMPOUNDED COOKING FATS REGISTERED IN THE UNITED STATES PATENT OFFICE, TO 1930 284

E. EXCERPTS FROM THE UNITED STATES FOOD ADMINISTRATION REGULATIONS 306

F. TABLES 314

APPENDIX TABLES

TABLE PAGE

I. Cottonseed Produced and Crushed, Crude Oil Produced, and Oil Exported, Annually, from 1874–75 . 314

I *A*. Exports of Cottonseed Oil, Crude and Refined, 1922–33 316

II. Aspegren Estimates of Domestic Uses of Cottonseed Oil, Annually from 1874–75 to 1911–12 317

III. Aspegren Estimates of Uses of Exported Cottonseed Oil, Annually from 1874–75 to 1911–12 318

IV. Classification of Trade-Mark Registrations of Compound, 1868–1930 319

V. Exports of Compound, Annually from 1892–93, and of Lard, Annually from 1873–74 320

VI. Exports of Compound to Principal Areas of Reported Destination, Annually from 1896–97 322

VI *A*. Exports of Compound to Principal European Countries of Reported Destination, Annually from 1896–97 323

TABLE PAGE

VI *B*. Exports of Compound to Principal ex-European Countries of Reported Destination, Annually from 1896–97 325

VII. Shipments of Compound and Lard to Possessions, Annually from 1896–97 326

VIII. Factory Production of Lard, Compound, and Cottonseed Oil, Quarterly, 1922–33 327

IX. Lard Production, Exports, and Apparent Domestic Consumption, 1900–32 328

X. Compound Production, 1908–33, According to Available Data and Estimates 330

XI. Compound and Lard Production in the Meat-Packing Industry, Compared with Total Output of the Industry, Census Years 1899–1931 331

XII. Census of Manufactures Data on Production of Compound, 1914–31 332

XIII. Census of Manufactures Classified Data on Compound Produced in the Shortenings (Other than Lard) Industry, 1925–31 334

XIV. Shortening Materials Used in the Commercial Baking Industry, Census Years 1923–31 335

XV. Cost of Principal Materials Used in the Commercial Baking Industry, Census Years 1923–31 336

XVI. Relative Importance of Vegetable Oil Compounds and Compounds Containing Animal Fats in Exports, 1922–32, and in Production in Part of the Industry, Census Years 1925–31 337

XVII. Raw Materials Used in Manufacture of Compound, in Specified Years, 1912–33 338

XVIII. Animal and Vegetable Fats and Oils (Other than Cottonseed Oil) Used in Manufacture of Compound, in Specified Years, 1912–33 339

XIX. Tariff Duties on Fats and Oils and Their Food Products, 1883–1932 341

XX. Approximate per Capita Consumption of Lard, Compound, Butter, and Margarine, Annually, 1900–32 . 342

TABLE PAGE

XXI. Wholesale Prices of Lard, New York, Monthly, 1875–1933 343

XXII. Wholesale Prices of Cottonseed Oil (Prime Summer Yellow), New York, Monthly, 1875–1933 345

XXIII. Wholesale Prices of Compound, New York, Monthly, 1897–1933 347

XXIV. Wholesale Prices of Oleostearin, New York, Monthly, 1892–1933 348

XXV. Excess of Lard Prices over Prices of Cottonseed Oil and Compound, Annual Averages, 1875–1933 . . 349

XXVI. Prices of Cottonseed Oil and of Compound, Expressed as Percentages of Lard Prices, Annual Averages, 1875–1933 350

INDEX

Index 351

THE AMERICAN VEGETABLE-SHORTENING INDUSTRY: ITS ORIGIN AND DEVELOPMENT

CHAPTER I

HISTORY OF THE INDUSTRY UP TO 1890

The Subject

This book is devoted to those manufactured solid fat products other than pure lard which in America are used in cookery. Four types have been developed in the course of time, namely:

1. Mixtures of lard and edible tallow or stearin (see p. 9), with or without cottonseed oil or other edible vegetable oil.
2. Mixtures of stearin or edible tallow and cottonseed or other vegetable oil, with or without some lard.
3. Cottonseed oil or other vegetable oil or a mixture of different vegetable oils hardened to the consistency of lard by chemical means.
4. Mixtures of chemically hardened fish or whale oil and a vegetable oil, commonly cottonseed oil.

Type 1 was the first produced; originally, it was merely adulterated lard. Types 1 and 2 are known in the trade as lard compound, compound lard, or simply as "compound." Type 3 has long been known as vegetable compound and is now coming to be known as vegetable shortening. Type 4 is as yet quite unimportant in the United States, except locally, and is not differentiated from compound by the trade.

In the trade and in official statistics, these cooking fats are known as lard compound, shortening, or lard substitutes. These designations are not satisfactory for the purposes of this treatise. The phrase "lard compound" implies that lard is always an ingredient, which is no longer the fact; "shortening" is misleading since the product is used for other purposes as well as for shortening; "lard substitutes" conveys the implication of inferiority which is not justified. The term "manufactured cooking fat" describes the subject of this book accurately, since the adjective "manufactured" serves to distinguish these fats from lard and edible tallow. The word "fat" distinguishes them from oils that are also used for cooking. The precise phrase is, however, unwieldy. In this book, therefore, the word "compound" will be used as a generic term for all compound cooking fats.

The principal ingredients of compound are joint products: cottonseed oil with cotton; tallow or oleostearin with beef and veal; and tallow also with wool and mutton. Each of these ingredients is a subordinate joint product; the volume produced has a tendency to vary, but the supply responds not so much to changes in the price of the by-product as to factors largely independent of this. The supply of cottonseed oil nowadays depends principally upon the size of the cotton crop, and that of tallow upon the number of animals slaughtered; these in turn are influenced by the returns from all joint products and other more or less fortuitous factors, including weather. Moreover, when manufactured into compound, these joint products compete with another joint product, lard, produced jointly with pork. The supply of lard, also quite variable, is likewise not closely responsive to changes in its price, since it depends upon the size of the hog slaughter, which in turn is correlated among other factors with the size of the corn (maize) crop.

The demand for lard and compound combined is fairly inelastic, that is, the quantity consumed does not vary readily in response to changes in price. The long-time trend of consumption is upward, owing to population growth and perhaps also to increased per capita consumption. The demand for any one of these fats, however, is variable, as price relationships among them change, though, as will be shown, there is an increasing element of stability in the demand for compound.

All these circumstances provide for the compound industry an economic setting of peculiar interest. It has shown a remarkable growth, in which it has drawn into food use what was formerly a wasted by-product of cotton growing. The industry involves some of the most complex relationships among costs, price, and supply. It therefore presents material of great significance to students of two difficult fields of economic theory—that of substitute commodities and that of joint products—both of which are far more important in actual experience than is generally appreciated.

Because compounds compete with lard and also create an outlet for cottonseed oil, the compound industry affects profoundly two major agricultural enterprises in the United States, hog farming in the corn belt and cotton farming in the Southern states. An adequate study of compound must, therefore, reach to the roots of these two American agricultural enterprises and should contribute in some measure to clearer thinking concerning American national policies toward agriculture. It is in the hope of making some contributions in both of these directions that this book has been written.

The Use of Fats for Cooking and Shortening

The food value of ordinary fats and of ordinary oils is practically the same. Their varying consistency is not

reflected in nutritive value. At low temperatures, all oils become solid fats, and, at higher temperatures, all solid fats melt and become oils. It would, therefore, be a matter of indifference whether the diet contains fats or oils, if it were not for the rôles played by habit, custom, and flavor, and if it were not for the use of fats and oils as shortenings.

In cookery, two of the more important uses of fats are for frying and for shortening. Fats incorporated in a leavened baked product modify its texture — make it "short," that is, give it a more friable or crumbly character than it would otherwise have.[1] Leavened products, however, can be made only from wheat and rye flours, for these alone among cereal flours yield an elastic dough when mixed with water. An elastic dough is necessary for the production of leavened products; by virtue of its elasticity and tenacity, it entraps the bubbles of leavening gas so that the baked product becomes porous. Other cereal flours, when mixed with water, give a paste or batter, rather than a dough. Such a batter cannot retain the leavening gas and is, therefore, incapable of yielding porous, or "leavened" products. This is the reason why leavened products cannot be made from corn (maize) meal alone. Baked products made from corn meal or corn flour, such as corn pone and johnny cake, are already crumbly or friable; they do not require the use of fat to make them "short." If fat is used in the preparation of corn-meal products, it is rather to add flavor and food value than to shorten. For the same reason, baked products made from other cereal meals, such as barley or oats, cannot be leavened. The product tends to be hard, tough, and brittle. It is made more friable by the use of shortening, but this practice has never been widely adopted.

[1] For a discussion of the action of shortenings, see Appendix C.

While the consistency of a fat for frying is immaterial since it is melted in use, the consistency of a shortening is of prime importance. Because the shortening material, the fat, is mixed with the other ingredients before baking, it is necessary that it be capable of being distributed uniformly through the mixture. It must, therefore, possess a certain degree of softness and plasticity. It must not be too soft, like an oil. If it is, it is liable to cease remaining uniformly distributed in the mix, the fine droplets of oil tending rather to run together. Moreover, if an oil be used in formulas that demand much shortening, it tends to run out of the baked product and make the product feel, taste, and look greasy. The commonest fats that most nearly fulfil the requirements for an ideal shortening with respect to softness and plasticity are butter and lard; most vegetable oils in their natural state are too fluid, while beef and mutton fat (tallow) are too hard and not sufficiently plastic.

Since it is only in baked wheat and rye products that fats are used extensively to shorten, the use of shortening is greatest in those parts of the world where baked products of wheat and rye are widely consumed. These regions are central and western Europe and those countries that have been settled by Europeans—the Americas, Australia, New Zealand, and parts of Africa. Perhaps parts of Asia, especially western Asia and some parts of India and China, where wheat is an important food, might be included. In central and eastern Asia, comparatively little of the wheat that disappears is consumed in leavened baked products,[1] and the use of shortenings is correspondingly restricted. The per capita consumption of shortenings has probably been greater in the United States and Canada than elsewhere, because the character

[1] Wen Yuh Swen and Carl L. Alsberg, "Japan as a Producer and Importer of Wheat," *Wheat Studies of the Food Research Institute*, July 1930, VI, 351.

of the bread consumed in these countries has undergone a change in recent decades. While in Europe bread is still made only from flour, salt, yeast, and water, in America the great bulk of the bread is made from these ingredients with the addition of shortening, and often of sugar and skim milk as well, from one to several pounds of shortening to the barrel of flour being used.

A number of circumstances have conspired to implant deeply in northern and northwestern Europeans, and their descendants in other regions, a preference for butter and lard. The primary cause is, of course, that these have for ages been *the* familiar fats, for in northern Europe there have long been a large dairy industry and a widespread swine husbandry, whereas oil-producing crops have never been of large importance there. In the absence of any domestic agricultural supply of food oil and in view of the demand for shortening, it is natural that lard, next to butter, should have been for centuries the preferred cooking fat of northern Europeans; and they have transmitted this preference, along with other dietary habits, to their descendants in other parts of the world. The preference for lard and butter as cooking fats is, however, based not solely upon their availability, or upon habit; it probably depends in part upon the characteristics of these shortenings and the prominence of wheat and rye in the diet. In Christian Mediterranean Europe, where dairying and swine husbandry are not much developed, the preferred fat has long been olive oil. Of non-Christian peoples, the only important users of lard are the Chinese, though per capita consumption in China is probably small because of the low economic plane of living prevailing there.

It is, therefore, in northern Europe or America that one should expect to find the beginnings of a lard-substitute industry; and these beginnings should be fairly re-

cent, since only in recent times has the supply of lard and tallow failed to keep pace with the rapidly increasing demand. The industrial revolution created a great need for lubricants and for fat for other technical uses. Population grew and the standard of living rose. Better lighting and more cleanliness were demanded, both of which could be supplied only by using more fats and oils for lamps, candles, and soap. The growth of railways created heavy demands for fats in lubrication. Not the least factor was the cheapening of textiles through the greater availability of cotton, for cotton goods, unlike woolens, are easily washed with soap. Accordingly, one finds in the writings of the first half of the nineteenth century numerous references to the growing scarcity of fats and oils.[1] Western Europe began to import fats and oils heavily and the lag in supply relative to demand continued there throughout the century.[2] Indeed, beginning in the second half of the nineteenth century, the supplies of hard animal fats available for import into Europe tended to be curtailed.

> The development of the meat-canning industry, while it stimulated the consumption of meat by the growing populations of Europe, deprived the trade of the carcasses which had previously been boiled down for the supply of fats and oils. None the less, the demand for edible fats continued to increase, and for the first time cottonseed oil in the frying of fish was consumed by the poorer classes. With the turn of the century, we enter upon yet another phase. Cold-storage facilities were perfected, leading to the importation and marketing of whole carcasses and a still further reduction in available supplies of animal fats.[3]

In consequence, Europe began to substitute hard vege-

[1] For example, J. B. Dumas writes, "Les huiles à brûler et les suifs deviennent de plus en plus chers et recherchés" (*Traité de Chimie Appliquée aux Arts* [Paris, Béchet jeune, 1843], VI, 610).

[2] Cf. Lassar-Cohn, *Die Chemie im täglichen Leben* (Hamburg and Leipzig, Leopold Voss, 2d edition, 1897), 60–61.

[3] *Report of the Imperial Economic Committee on Marketing and Preparing for Market of Foodstuffs Produced within the Empire: Fourth Report—Dairy Produce* (Cmd. 2725, London, 1926), 115.

table fats, notably palm kernel and coconut oil and coconut stearin, about 1890.[1] These fats had long been employed in Europe in the candle and soap industries. It was about this time that they seem first to have attracted attention in the United States;[2] but they were not used in cooking fats to any considerable extent till about twenty years later.

Origin of the Industry in America

There are records of the production of compounded solid cooking fats in Europe as a household practice in the first half of the nineteenth century.[3] Very likely they date back much farther. About the middle of the century, there was even some commercial production,[4] but the manufacture of compound first developed on a considerable scale in the United States in connection with the lard industry itself. Its beginnings are found in the adulteration of lard, which was common and widespread. In 1875, some use was made of a process of adulterating lard with as much as 25 per cent of water by adding a small quantity of milk of lime to melted lard.[5] The "soap" thus formed would hold water and remain firm and white. A more ancient practice is the addition of tallow for the purpose of giving lard to be used in warm weather a firmer consistency. No doubt, this practice was at times abused and then represented a form of adulteration.

The need to stiffen lard for use at all seasons and not merely in summer arose in America about 1840 with the introduction of steam rendering. The word "lard" before that time had meant the fat rendered from the leaf of the

[1] R. Bodmer, "Über Larderine," *Chemisches Centralblatt*, March 20, 1895, LXVI, Band I, 665.

[2] United States Patents No. 468,498 (February 9, 1892) and No. 432,251 (July 15, 1890).

[3] See Appendix B, p. 259. [4] *Idem.*

[5] *Oil, Paint, and Drug Reporter*, May 26, 1875, VIII, 1.

pig, that is from the kidney and bowel fat. Steam rendering[1] made it possible to obtain fat not merely from the leaf and other fats trimmed off from the meat, but also from most of the rest of the carcass, which contains a much smaller proportion of fat. At the time of the introduction of steam rendering, railroad transportation was still in its infancy and, in consequence, only the choicest cured meats could be shipped profitably for considerable distances. West of the Appalachians, large numbers of entire hog carcasses, except for the removal of the hams, were steam-rendered. The hog fat thus produced appropriated the name of lard: it was known, very naturally, as "whole hog lard." Later, it became known to the trade as "steam lard," but was passed on to the consumer simply as lard. It was less acceptable because softer than the lard to which he had been accustomed. Producers, therefore, stiffened it by adding harder fats, especially lard stearin,[2] and sometimes tallow. In doing so, they simply adapted to new conditions an old practice of butchers and farmers; but they carried the practice to such extremes, as we shall see, that for many years it was an important channel for marketing stearin, and ultimately gave rise to the lard-substitute or compound industry.

Progressive adulteration of lard in the United States was promoted by the fact that few packers refined their own lard. This was done largely by independent concerns, the N. K. Fairbank Company of Chicago being the one outstanding organization to which packers sold their steam lard. The packers, therefore, had no particular interest in maintaining the quality of lard. The position of refiners became especially difficult with the rise of the margarine industry, for packers then did not hesitate to

[1] See Appendix B, p. 244.

[2] For a discussion of the nature and mode of production of stearin, see Appendix A, pp. 226, 230, and Appendix B, pp. 234 ff.

sell leaf lard to margarine makers rather than to refiners. As we shall see, the refiners were then faced with injury to their reputation through deterioration of the quality of their branded goods, and were, therefore, under the necessity of adapting their product to the changed conditions.

Influence of the Margarine Industry

The rise of the margarine industry in the 'seventies and its growth during the 'eighties[1] brought about conditions in the fats and oils markets that were favorable to an extension of lard-adulteration practices, and eventually to the promotion of the compound industry. Margarine manufacture created a demand for fats of bland flavor and semi-solid consistency. The most available of these at this time were derived from the visceral fats of hogs and cattle. American meat packers met this demand by dividing their lard into two grades. The better grade was produced by removing the leaf fats from the carcass as soon as feasible after slaughter and rendering them in water at low temperature. Because the product was bland and without any cooked flavor, it was known as neutral lard. The remaining fats, steam-rendered, yielded what was known as "prime steam lard." So much neutral lard was sold to margarine producers that a large portion of the lard sold to lard refiners was inferior in consistency and texture to the steam-rendered lard described in a previous paragraph.[2] This inferiority resulted from the removal of the leaf fats, which are the source of the best and stiffest lard. Therefore, since much of the prime steam lard produced after the rise of the margarine in-

[1] Cf. K. Snodgrass, *Margarine as a Butter Substitute* (Fats and Oils Studies of the Food Research Institute, No. 4, December 1930), chap. ii.

[2] C. W. Allbright, "Some Reminiscences of a Fat and Oil Chemist," *Chemical Age*, July 1924, XXXII, 295.

dustry was softer than was required by the trade, a further stimulus was given to the practice of hardening this lard by the addition of lard stearin or beef tallow. Some such adulteration had previously been necessary when the lard was soft, or when it was designed to stand up in hot weather, or when it was destined for export to warm countries. The rise of the margarine industry, therefore, led to the extension of an existing practice.

The margarine industry had another important influence in promoting the growth of the compound industry. It introduced a demand for oleo oil, which is the oil expressed from tallow of the best edible grade.[1] Before this time, tallow had been pressed for industrial purposes, primarily to furnish tallow stearin for the candle-maker, while tallow oil, the by-product, was used in various ways in the arts. Relatively little tallow had been used as such for food purposes, at least in the United States, although it is probable that some was employed to stiffen lard, and that butchers worked some into sausage and other meat products. There was doubtless some food use in the home for tallow rendered from fat trimmed from meats. Probably, also, some of the tallow exported to Europe found its way into certain food products. But in the United States, previous to the advent of margarine manufacture, there was little trade in edible tallow or products made therefrom.

The growing demand for oleo oil from the new and rapidly expanding margarine industry made it profitable for packers to segregate tallow into two grades, edible and inedible. Inedible tallow continued to be used in the arts as before, either directly or in the form of its derivatives, tallow stearin and tallow oil. That portion of edible tallow which was handled most carefully and rendered with water at low temperatures, much as is neutral lard,

[1] For a discussion of pressing, see Appendix A.

became known as oleo stock (in Europe, *premier jus*).[1] Oleo stock was produced solely to be separated into oleo oil, for use in margarine, and oleostearin. Thus, the new and increasing demand for oleo oil for the margarine industry at home and abroad made available large quantities of by-product oleostearin, a hard, high-grade, edible fat.[2] Food uses had to be found for this, if it was to share appreciably with the oil in carrying the cost of acquiring and pressing the high-priced edible tallow; otherwise, the edible oleostearin would have had to be disposed of to industry in competition with inedible, low-grade fats.

Naturally, this oleostearin soon found a partial outlet in stiffening lard, for which lard stearin or beef tallow had been used. Being stiffer than tallow, a given amount would go further. In spite of the increased amount of soft lard on the market, however, this outlet was insufficient to absorb the supply, and the existence of large quantities of oleostearin furnished a direct stimulus to the growth of the compound industry.

In the 'seventies, lard refiners produced principally refined lard, lard stearin, lard oil, grease, and grease oil. Lard refining was largely an art rather than a science, and the success of the refiner depended in considerable measure on his skill in blending lards of different flavors and in working in as much off-flavored lard as a given trade would stand. Of such off-flavored lard, there was a good deal. It consisted in the main of lard badly rendered and having a cooked or burned flavor, and of lard that had become rancid. In the 'seventies, packers began to add such lard to their prime steam lard, which they

[1] Theretofore, in tallow pressing, the stearin had been the major product, and the oil the by-product. The margarine industry thus reversed the relative importance of the two products, at least so far as the edible portions were concerned.

[2] Edible tallow other than oleo stock is produced, but tallow oil is pressed only from inedible grades of tallow. See Appendix A.

sold to the refiners. The most important equipment of a lard refiner, therefore, was a delicate, trained sense of taste, and experience in producing, from the cheaper materials available, types of lard demanded by different classes of consumers. The refiner was also under the necessity of adapting the texture of lard to the climate to which it was to be shipped. For warm climates, or for the summer season, it was stiffened first with lard stearin and later with tallow. Such lard was sometimes known as "Cuba lard." For colder climates or seasons, of course, softer lard could be used. With increased supplies of cheaper fats from cattle and sheep and with the development of better technique for their successful utilization, it became an increasingly common practice to add fats other than hog fats to so-called refined lard.

Rise of the Cottonseed-Oil Industry

In addition to the developments already mentioned involving animal fats, the 'seventies and 'eighties saw the introduction and rapid expansion in production of edible oil expressed from cottonseed (see Chart 1, p. 14). Until shortly before the Civil War, cottonseed oil cannot be said to have been commercially produced. The earliest attempts at extracting oil were financially disastrous, and it was not until 1855[1] that undertakings were established in Providence, R.I., and New Orleans which gave real promise of becoming profitable. These enterprises, however, like many others, were suspended by the Civil War. Indeed, until 1870, the industry was largely in the experimental stage, in which efforts were concentrated on the development of suitable machinery for crushing the seed. In 1867, according to Lamborn,[2] there were only four

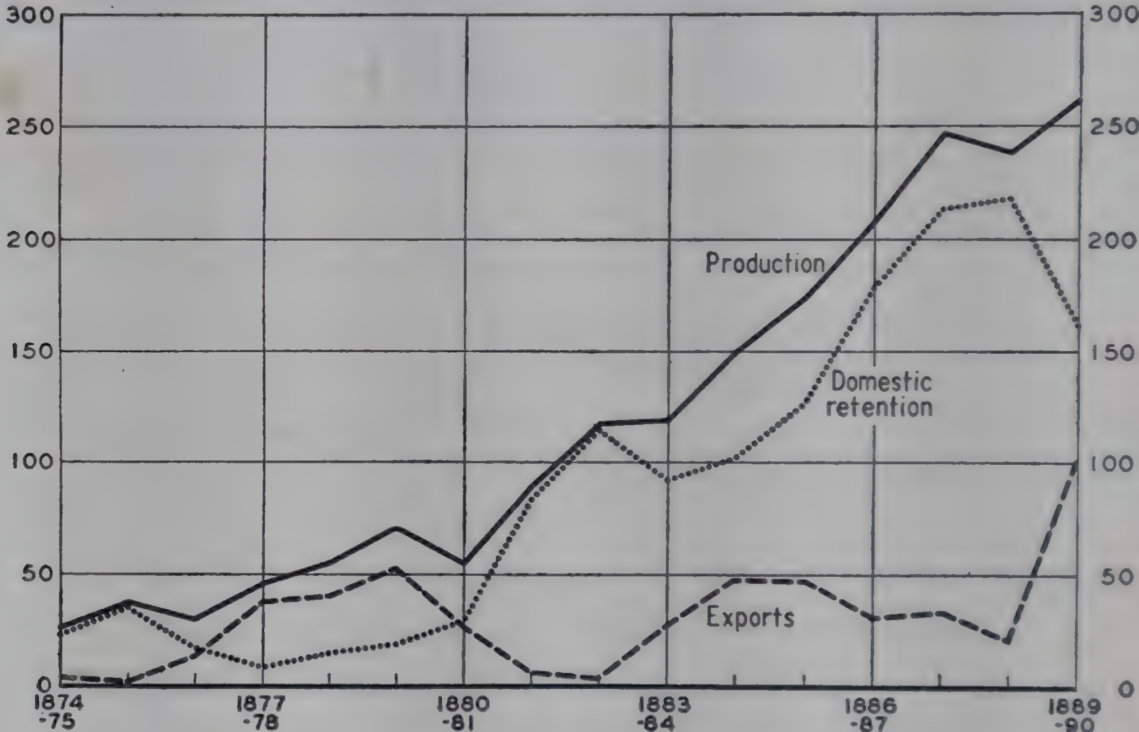
[1] *Proceedings of the Meetings of the Cottonseed Crushers' Association held in New York, June 1882*, pp. 2–4.

[2] L. L. Lamborn, *Cottonseed Products* (New York, van Nostrand, 1920), 22.

cottonseed-oil mills in the United States. According to the census reports, however, there were 26 mills in 1870, 45 mills in 1880, and 119 mills in 1890.[1] The output of oil from the cottonseed-oil mills likewise increased rapidly, from slightly over 25 million pounds in 1874–75 (Table I)[2] to nearly 71 million in 1879–80 and some 262 million in 1889–90.

CHART 1.—COTTONSEED OIL PRODUCTION, EXPORTS, AND DOMESTIC RETENTION, 1874–75 TO 1889–90*

(Million pounds)



* See Table I. Production data for these years are official estimates, necessarily somewhat rough, for years August–July; exports for years July–June; domestic retention figures obtained by subtraction, disregarding the lack of identity in years covered.

In several of the earlier years, as indicated in Chart 1, most of the cottonseed oil produced in the United States was exported. In fact, during the five years ending June 1881 exports aggregated about two-thirds of the total do-

[1] *Twelfth Census of the United States, 1900*, IX, Manufactures, Part III (Washington, 1902), 589.

[2] All tables thus numbered are to be found in Appendix F.

mestic production, while for the three years ending June 1879 they were over three-fourths of the total (see Table I). In the beginning, Italy was the chief export market. According to United States export statistics, tabulated below in million pounds, she took considerably over 40 per

July–June	Exports total	Exports to Italy	Percentage to Italy	July–June	Exports total	Exports to Italy	Percentage to Italy
1875–76	2.1	1.0	48	1882–83	3.1	0.0	0
1876–77	12.8	6.6	51	1883–84	27.0	8.0	30
1877–78	37.4	11.8	32	1884–85	47.7	10.3	22
1878–79	40.1	17.6	44	1885–86	46.8	6.1	13
1879–80	52.5	23.2	44	1886–87	30.5	2.6	8
1880–81	25.8	5.6	22	1887–88	33.4	2.1	6
1881–82	5.4	0.8	14	1888–89	20.2	0.5	2

cent of our total exports up to June 1880. The rapid increase of cottonseed-oil imports into Italy caused alarm among Italian olive growers, who feared the destruction or demoralization of the foreign as well as the domestic demand for their product. Large quantities of cottonseed oil were being mixed with olive oil, or completely substituted therefor, and sold as olive oil. Even cottonseed oil sold under its own name was a competitor of the more expensive product, particularly among low-income classes. This adulteration and substitution existed not only in the domestic markets of Italy and other Mediterranean countries, but also in their exports. It was a commonly accepted fact that a great deal of the so-called olive oil imported into the United States contained considerable cottonseed oil which had previously left our shores under its true name.[1]

Italian olive growers therefore turned to their government for relief from this menace to their industry. In 1881 they succeeded in getting the duty on cottonseed oil in-

[1] Repeated reference to this fact occurs in commercial journals of the period, such as the *Oil, Paint, and Drug Reporter* and the *Cincinnati Price Current*. At the 1882 meeting of the Cottonseed Crushers' Association it was discussed quite openly.

creased from 6.5 cents to 16.6 cents per gallon.[1] As they desired, our exports to Italy dropped precipitously to practically nothing in 1882–83.

The sudden curtailment in the exports of cottonseed oil from the United States was not confined to Italy. From a peak of 52.5 million pounds to all countries in 1879–80, our cottonseed-oil exports sank to 5.4 million pounds in 1881–82 and to 3.1 million pounds in 1882–83. The virtual disappearance of cottonseed-oil exports (which proved only temporary) is by no means fully explained on the basis of the Italian tariff. It occurred in a period of prosperity at home (Chart 2) and abroad,[2] under fairly stable financial conditions and active international trade. It was not caused by a falling off in output of cottonseed oil, which, after a drop in 1880–81, reached new peaks in the two following years[3] (see Chart 1). Presumably European domestic supplies of fats and oils were temporarily so abundant that the demand for imported fats and oils declined. For several years prior to 1881 corn prices were low and exports large. This may have facilitated expansion of swine husbandry in Europe. Italy's trade statistics indicate that her olive crop was large in 1881 and 1882.[4]

Whatever the causes of the shrinkage of cottonseed oil exports in the early 'eighties, domestic production

[1] This increase went into force on April 22, 1881, but shipments were made under contracts which ran until the end of 1881.

[2] See W. L. Thorp and W. C. Mitchell, *Business Annals* (New York, National Bureau of Economic Research, Inc., 1926), 24, 28, 78, 95, 133–34, 169, 191, 209, 224.

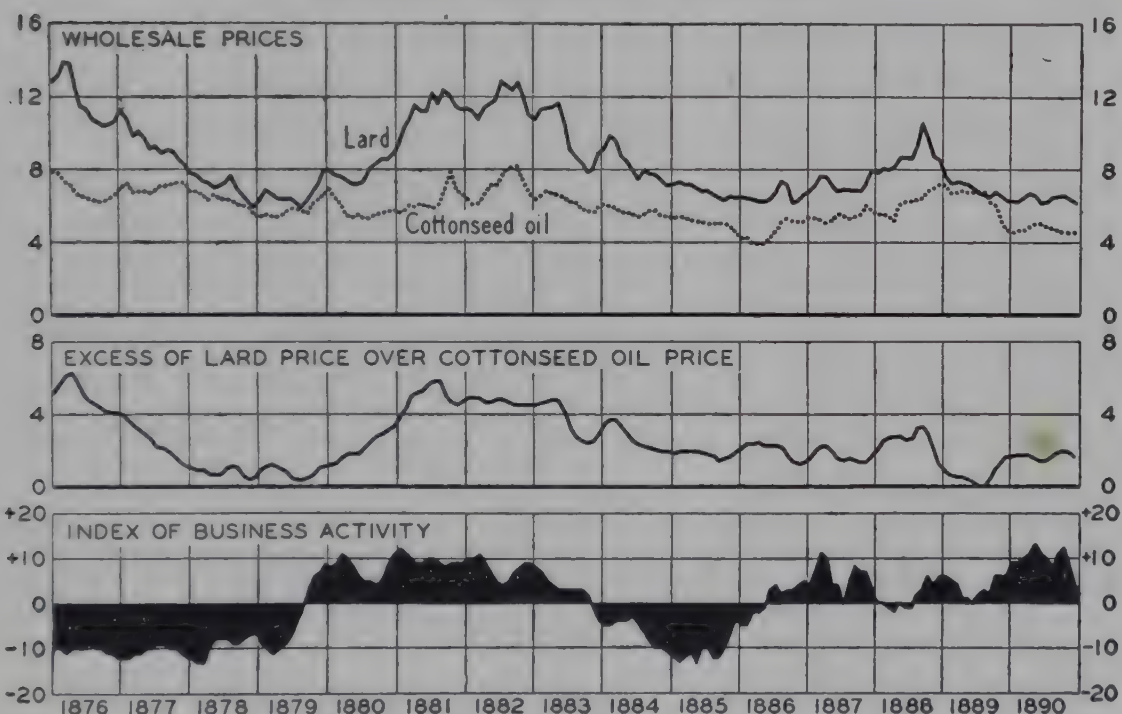
[3] The cotton crop of 1881 was short; but this was not a limiting factor, for only a small fraction of the available seed was crushed (Table I).

[4] Net exports of olive oil and net imports of other "fixed oils," including cottonseed oil, according to Italian official statistics (*Annuario Statistico Italiano*, 1900, pp. 606–07), were as follows in thousand quintals:

Year	Net exports	Net imports	Year	Net exports	Net imports	Year	Net exports	Net imports
1875	845	98	1880	562	200	1885	178	178
1876	793	100	1881	588	143	1886	594	155
1877	558	167	1882	795	44	1887	595	122
1878	502	178	1883	696	53	1888	493	55
1879	837	136	1884	445	105	1889	495	28

grew by leaps and bounds, and domestic consumption increased enormously, with only a temporary setback in the depression of 1883–85. Mills were being erected in new localities and large additional quantities of oil were poured into the market. Largely because of technological developments shortly to be mentioned, production of oil jumped from under 30 million pounds in 1876–77 to 117.6 million in 1882–83. Whereas slightly over 7.7 million pounds were retained for domestic consumption in 1877–78 and about 18 million in 1879–80, there were available about 83 million in 1881–82 and 114 million in 1882–83 (Chart 1, p. 14).

Chart 2.—Wholesale Prices of Lard and Cottonseed Oil, Spreads between Them, and Index of Business Activity, Monthly, 1876–90*



* Prices from Tables XXI and XXII, in cents per pound; Cleveland Trust Company index of business activity, in percentages above and below estimated normal. The price spread is a three-month moving average of monthly spreads.

The cottonseed-oil trade was thus confronted almost overnight with the problem of disposing of a tremendously augmented supply. Unless high-quality oil was to

sell at such low prices that it could be profitably used in soap making, food outlets had to be greatly expanded. Actually, cottonseed-oil prices were depressed relatively to lard (see Chart 2) and large quantities were used for soap, but also salad oils absorbed somewhat larger amounts and new food outlets were found. The introduction of cottonseed oil for various edible purposes at this time, according to Lamborn,[1] "at least at the North, may be credited in no small degree to the receivers and brokers who had the oil to sell and were compelled to force it into any channel that could be opened." It had recently been discovered that cottonseed oil could be used profitably not only as a lard adulterant, but also in the making of margarine and in packing American sardines in Maine. The amounts of cottonseed oil consumed in these industries expanded rapidly.[2]

An important factor doubtless helped the cottonseed-oil industry, without disastrous price recessions, to dispose of the immense quantity of oil which had suddenly become available, and at the same time to gain for cottonseed oil a more secure footing among edible fats. Lard prices were above normal from early in 1881 to the middle of 1883 (Chart 2). The rise in lard prices at this time was part of an upward swing in prices which marked the period of prosperity in the early 'eighties, and partly the result of a very short corn crop in 1881. During this period, lard commanded prices which were not again reached until 1909–10, except for a brief period early in 1893[3] (Table XXI). So far as cottonseed oil could be offered as a substitute cooking fat, either under its own name or as an adulterant in "refined lard," it afforded a

[1] *Loc. cit.*

[2] See Aspegren estimates in Table II.

[3] During 1881, 1882, and the first half of 1883, wholesale lard prices averaged well over 11 cents per pound; so high an average was not again attained for any twelve-month period until 1909.

welcome supplement to the relatively small and high-priced stocks of hog lard then available.

Its possibilities as a salad and cooking oil were also being developed. As early as 1874 the Union Oil Company of Providence, R.I., advertised "pure salad oils," and "olive flavored oil" in retail-sized bottles. Soon after, the Hope Oil Mill of Memphis began making a specialty of "Hope Butter Oil" for cooking purposes. To some extent, principally in the South, the best refined cottonseed oil was being used as a substitute for lard in cooking.[1] Expansion of this outlet was retarded during the 'seventies and early 'eighties by unsatisfactory methods of refining, by lack of uniformity in the quality of the oil, and by the practice of some producers of putting inferior grades on the market. In spite of these facts, an expert of the Census of 1880 stated that "refined cottonseed oil is superior to lard for cooking; not only for salad oil, but for all purposes for which lard is used. In taste it is superior and sweeter, and, being vegetable, is easier digested, less heat producing, and therefore, principally in this climate, a healthier food."[2] This statement represents a somewhat generous estimate (perhaps with a Southerner's bias) of the quality of most of the refined oil available up to that time, for the skill of both the engineer and the chemist was just beginning to be applied.

Influence of Technical Improvements in Cottonseed-Oil Production

The American engineer, according to Tompkins, first took an interest in cottonseed-oil mechanical equipment in the early 'eighties. From 1880, he says, "great improvement has been made in machinery, such as improved

[1] *Cincinnati Price Current*, April 5, 1877, XXXIV, 2.

[2] E. W. Hilgard, "The Production and Uses of Cottonseed and the Cottonseed-Oil Industry," *Tenth Census of the United States, 1880*, Cotton Production, Part I (Washington, 1884), 59.

hullers, improved linters, steel plate boxes in presses, chilled rolls in place of mill stones, etc."[1]

It is doubtless more than a coincidence that the increasing availability of cottonseed oil in the early 'eighties, resulting both from an expansion of cottonseed-pressing activity and from the curtailment in exports, was accompanied by important technical improvements in refining the oil. In this field, Joseph Sears, vice-president of the N. K. Fairbank Company, lard refiners of Chicago, was probably the first to appreciate the probable value of an application of chemistry to the changing conditions within the industry. The employment of a chemist by this concern in 1879 marks the initiation of this policy, which was to result in a series of improvements and inventions sponsored by chemists and other technical members of the staff. These developments kept this company far in advance of its competitors for some twenty years.

One of the circumstances that limited the use of cottonseed oil in the adulteration of lard was its yellow color. In its use as an adulterant or substitute for olive oil, this was not so much of a handicap, since olive oil has naturally a greenish-yellow color; but in lard, which the consuming public expects to be white, this color is objectionable. An improved method of bleaching cottonseed oil and lard with fuller's earth was developed in the works of the N. K. Fairbank Company about 1880. This was of great importance, for it made possible the addition of larger quantities of cottonseed oil to lard without affecting the color.[2] Subsequent improvements

[1] D. A. Tompkins, *Cotton and Cotton Oil* (Charlotte, N.C., published by the author, 1901, 2 vols.), II, 216.

[2] This discovery extended the demand for fuller's earth, and imports increased from considerably under 100 tons in 1879 and 1880 to 1,318 tons in 1883. Official data in *Commerce and Navigation of the United States* give value figures only for 1879 and 1880—$616 and $619, respectively. The value of imports in 1885 was $15,141.

made the process still more effective, and undoubtedly made it possible to use more cottonseed oil in lard without noticeably affecting its color or taste.

A further development in the process of making refined lard was to add excessive quantities of tallow, or stearin, and to counteract the too-great firmness resulting therefrom by adding more cottonseed oil.[1] Indeed, cottonseed oil was occasionally used to adulterate tallow.[2] The relative cheapness of cottonseed oil as compared with lard and other edible animal fats, resulting from the rapidly increasing supplies available, furnished the economic stimulus for this substitution, which technology had made possible.

Another factor operating during the 'eighties to increase the use of cottonseed oil in refined lard was the substitution of oleostearin for tallow as a stiffening agent. It has already been pointed out (p. 12) that large quantities of oleostearin became available as a by-product in the manufacture of oleo oil for margarine. As oleostearin is much stiffer than tallow, it will stand much heavier dilution with cottonseed oil. Among the earliest formulas used by the N. K. Fairbank Company was the following: 8 parts oleostearin, 38 parts cottonseed oil, 60 parts lard. This type of product proved so great a success that the company soon gave up making pure lard.[3]

Cottonseed oil can also be made to yield a stiffening agent. In winterizing or demargarinating cottonseed oil, appreciable quantities of white cottonseed-oil stearin are

[1] Some, however, believe that cottonseed oil was first used as an adulterant of lard and that tallow or oleostearin was then added to obtain the necessary hardness. See R. Grimshaw, "Industrial Applications of Cotton-seed Oil," *Journal of the Franklin Institute*, March 1889, CXXVII, 195.

[2] R. Williams, "On the Adulteration of Tallow with Cotton-seed Oil," *Journal of the Society of Chemical Industry*, March 31, 1888, VII, 186.

[3] W. B. Allbright, "Practical Considerations in Lard Manufacture," read before the American Meat Packers Association at Chicago, October 12, 1909, in *Catalogue No. 3*, The Allbright-Nell Company, Special Lard Machinery, Chicago, 1909.

obtained. If hard pressed, it is as firm as oleostearin and may be used to stiffen lard. Lard refiners used it for this purpose and to cheapen lard before 1875.[1] This was probably the earliest way cottonseed oil was used to adulterate lard. It is apparent, therefore, that lard refiners found in cottonseed oil an economical and convenient source of oil to soften an otherwise too-stiff product, or in stearin a material to harden one not sufficiently firm.

We find, therefore, that the 'seventies and early 'eighties witnessed a chain of related and unrelated events which conspired together to push the lard-refining industry along the path leading from simple adulteration, through more and more extensive adulteration, to the ultimate achievement of a new food industry. The rise of the margarine industry, the successful development of cottonseed crushing, the suddenly increased domestic supplies of cottonseed oil which became available at a time when lard prices were exceptionally high, and advances in fats and oils technology, all played their part in the establishment of the compound industry.

In the years immediately following 1881–82, the first year of large domestic consumption of cottonseed oil, there is ample evidence that lard refiners greatly increased their use of cottonseed oil. By 1887, when the matter of lard adulteration first drew Congressional attention, Armour and Company and the N. K. Fairbank Company together were probably using a substantial portion of the entire output of cottonseed oil in the manufacture of lard. Early in 1887, one of the Armour brothers publicly stated that his firm was absorbing one-fifth of the annual output of cottonseed oil in lard production, and another brother justified the use of the ingredient in

[1] *Oil, Paint, and Drug Reporter*, March 3, 1875, VII, 1; J. Muter, "Note on a Fat Recently Extensively Offered as an Adulterant for Lard," *Analyst*, June 1882, VII, 93, reported in *Pharmaceutical Journal and Transactions*, June 24, 1882, XII, 1051.

words of praise for the superior qualities of cottonseed oil that were as warm as those emanating from the cottonseed-oil interests themselves. Evidently, they felt that the use of cottonseed oil in lard production had come to stay.[1] If the Armour statement is accurate, the compounding of lard must have accounted for close to half the aggregate cottonseed crush at that time, since the N. K. Fairbank Company was the largest single consumer of cottonseed oil for use in lard refining.[2]

By the middle 'eighties or thereabouts, the term "compound lard" had begun to appear in trade circles, although most of the numerous brands of shortening containing mixtures of lard and other fats continued to be marketed as refined lard. Within the trade, at least, there can have been no widespread ignorance of the fact that refined lard was not pure hog lard, although the fact doubtless escaped the notice of many domestic consumers. Nor was there, apparently, any disposition on the part of the largest producers to keep the matter as quiet as circumstances would permit. This more or less anomalous condition in the lard-refining industry was soon changed, however, by legal prosecution in England under the Sale of Foods Act, and by adverse legislation and threats of adverse legislation in the United States. Developments in this field constitute the subject-matter of the following chapter, but it may be stated here that by the latter half of 1888 both Armour and Company and the N. K. Fairbank Company had found it expedient to announce that henceforth all mixtures of pure lard with other fats would be labeled as lard compounds.

[1] *Oil, Paint, and Drug Reporter,* March 9, 1887, XXXI, 6.

[2] *Cincinnati Price Current,* February 24, 1887, XXXI, 3. According to an article on the cottonseed-oil industry appearing in that issue of this periodical, "one-third to one-half cotton oil can be used in its [lard's] manufacture, for by the process of stirring refined lard as it cools the globules found in raw lard are destroyed and the combined product can only be distinguished from the genuine by chemists."

Disappearance of Independent Lard Refiners

In the meantime, other developments were taking place among lard refiners and producers of cottonseed oil which presaged the inauguration of lard compound as an independent product. The enormous increase in the use of cottonseed oil in lard production was a vital factor in the disappearance of the independent lard refiner.[1] The American Cotton Oil Trust, organized in 1884, first turned its attention to control of supplies through control of crushing mills and oil refineries. The N. K. Fairbank Company, the largest independent lard refiner in the country, was taken into this organization along with smaller concerns. By the end of 1888 the inroads of lard compound on the market for pure hog lard were so great as to force W. J. Wilcox and Company into the trust, and thus the largest independent lard refiner in the East passed out of existence. The following trade comment is worth quoting:

> The sharp competition between cotton oil and hog's fat is now the leading feature of the provision trade, and the fact that the wholesome vegetable oil is rapidly gaining supremacy was exemplified last week. . . . . The old and world renowned lard refining house of W. J. Wilcox and Co. has at last succumbed to the inevitable and passed into the hands of the American Cotton Oil Trust after a long and hard fight to maintain the supremacy of refined hog's lard over cotton oil. . . . . The result on the market for lard was thus stated by a broker, "We have no lard market here today, as the Wilcox Co., who have made the New York market one-half the time the past few years, and did at least one-half the business, are out of it, and not a trade in futures was made on the floor today."[2]

[1] It is likely that the packers would ultimately have taken over most of the business of refining the lard produced in their establishments, just as Armour and Company did from the early 'eighties; but domination of the cottonseed-oil interests by such a large concern as the American Cotton Oil Trust was at least as potent an influence, from the latter half of the 'eighties onward, in virtually forcing independent refiners out of existence. Another important influence was the decay of lard pressing, owing to the inroads made by petroleum products upon the demand for lard oil for illumination and lubrication.

[2] *Oil, Paint, and Drug Reporter*, November 7, 1888, XXXIV, 5, 9.

This disappearance of the independent lard refiner contributed toward making distinct the cleavage between hog lard and "cotton-oil lard." It aligned the producers into two groups, with the cottonseed-oil interests on one side and the meat packers on the other. The packers could, and did, produce both types of shortening, but the oil interests were primarily sellers of cottonseed oil and were users of animal ingredients only to the extent that they depended upon stearin or tallow for hardening agents and, perhaps, a little lard for flavor.

Early Patents for Compound

The practical demonstration by lard refiners during the 'eighties that acceptable lard-like shortening agents could be produced with a variety of formulas was accompanied by, and reflected in, a number of patents and trade-marks registered during this period. Here, too, we find evidence of a definitely emerging cooking-fat industry, and the choice of trade-marked names often suggested the vegetable-oil origin of their major ingredients rather than lard which they were designed to supplement or to supplant.

So far as can be ascertained, the first patent granted in the United States for the production of a lard compound was issued in 1871 to Henry W. Bradley, of Binghamton, New York. This inventor obtained two patents in that year, the first in January and the second in October. The first covered a process for making a shortening composed of "beef or mutton suet (tallow), three parts; refined vegetable or fixed oil, seven parts; hog's lard, stearin, two parts." The second covered a process for deodorizing and rendering palatable cottonseed oil for culinary use. The patent stated that the inventor also prepared cottonseed oil to the consistency of common lard by adding equal weight of suet or tallow. Evidently,

the second patent was for the purpose of covering the process of rendering cottonseed oil usable in the formula contained in the first patent.

The late 'seventies and early 'eighties witnessed a large number of inventions of processes and machinery for preparing edible fats, particularly margarine, or "artificial butter," as it was usually listed at that time in the Patent Office index. Among these were a number of patents on the subject of lard compounds or substitutes. Beginning in 1882, there seems to have been a marked increase in interest in devising new types of compounds, for a number of patents were granted in that year. These included three to Samuel H. Cochran, of Massachusetts, whose chief contribution appeared to be in the method devised of "purifying and deodorizing" cottonseed oil, beef fat, and swine fat by the use of slippery elm bark. He mentioned two formulas for cooking compound, one containing 68 parts cottonseed oil, 28 parts beef-suet oil, and 5 parts beef stearin, and the other substituting 28 parts of swine fat for the 28 parts of beef-suet oil in the preceding formula. Another compound patented in 1882 was invented by George S. Marshall, also of Massachusetts, who used orris root for purifying and deodorizing the animal and vegetable ingredients used. In the same year, Oscar H. Coumbe, of Washington, D.C., patented a process for making cooking fat, which, from evidence available, seems to have been the first formula relying solely on vegetable ingredients. He called his product "Oleard," but apparently this name was never registered among trade-marks filed with the Patent Office.

Trade-Marked Compounds and Lard Substitutes

A list of patented inventions obviously does not indicate the extent to which the ideas represented by these patents are translated into industrial and commercial

activities. An examination of trade-marks registered in the United States covering products in the field of cooking fats gives more direct evidence on developments in the compound industry. Such evidence is necessarily far from complete, since many products are put on the market without being trade-marked, particularly those designed for bulk sale rather than for retail distribution. Nevertheless, as early as 1882,[1] the files of the Patent Office contain records of trade-marks covering brands of lard compounds, lard substitutes, and similar products for culinary uses.[2]

The inventor Cochran gave the name "Purola" to one of his products, and registered this name in the summer of 1882, shortly before his patent was granted. That such a compound was actually marketed under this name is evidenced by advertisements appearing early in January 1883 in the *Oil, Paint, and Drug Reporter*, describing this article as "a valuable substitute for lard or butter, and far superior to either for all cooking purposes." Purola was manufactured by the Standard Butter Company, of Boston, under license from S. H. Cochran. It was put up in cans of three-, five-, ten-, and twenty-pound sizes; also in tierces, barrels, half-barrels, quarter-barrels, and tubs. It was evidently sold to bakers and other large users, as well as to household consumers. No earlier advertisement of a semi-solid cooking fat offered as a substitute

[1] In 1874, John Hobbs, of Boston, registered a product (No. 1842) under the name of "Cream-Suet," which was classed as a tallow compound and described as a substitute for butter, "to shorten or enrich biscuits and other products of cookery." The ingredients were not specified. While this product was designated as a butter substitute, its suggested uses indicate that it was designed to be used as a shortening agent, rather than as a spread for bread. Accordingly, it should probably be classed as one of the earliest, if not the earliest, of the shortening compounds registered with the Patent Office.

[2] A list, complete so far as can be discovered, of trade-marks for various types of compounds and substitutes, including purely vegetable shortenings, is given in Appendix D. Unfortunately, in many instances there is no mention of the specific ingredients. Table IV summarizes the list by years of issue and years in which manufacture of the product was reported to have begun.

for lard has been found by the writers in the trade journals of the period. Numerous brands of cottonseed oil were on the market in the form of liquid cooking and salad oils. At the time, and even later,[1] many individuals interested in the cottonseed-oil industry expected that this method of marketing the oil would ultimately become the most important.

In 1882, five trade-marks for products to be used as substitutes for lard were registered by Washington Butcher's Sons of Philadelphia, active in the organization of the Southern Cotton Oil Company a few years later. All five trade-marks suggested olive oil as an ingredient, although no information was given regarding the composition of any of the five. The first two registered were named "Olive Butter" and "Olivene." The other three were designated merely by pictures suggesting olive-oil content. Up to that time, it will be remembered, cottonseed oil probably had its chief food outlet as an adulterant of or substitute for olive oil. It is not known whether these products were liquid or semi-solid, but the name Olive Butter suggests that this one, at least, was of a consistency similar to that of lard.

Reference has already been made to the leading rôle played by the N. K. Fairbank Company, large refiners of lard, in developing processes and formulas for the manufacture of cooking fats. This leadership is well attested by records of the Patent Office, in which appear a considerable number of trade-marks for various types of lard compounds and substitutes. Apparently, the first compound (as distinguished from adulterated lard) to be produced by this company made its appearance in 1884. No trade-mark covering it was acquired until 1915,

[1] As late as 1911, Dr. Harvey Wiley stated before the meeting of the Interstate Cottonseed Crushers' Association that "if you want your cottonseed oil consumed, it must be on the table as salad oil." *Oil, Paint, and Drug Reporter*, June 12, 1911, LXXIX, 67.

when it was registered under the name "Snow White," and described as a "cooking compound containing cottonseed oil and oleostearin.[1]

In 1886, two years after the introduction of Snow White, the N. K. Fairbank Company began production of "Victoria," a cooking compound of cottonseed oil and oleostearin.[2] In 1887 the same company registered at the Patent Office and introduced to the public another shortening compound under the name of "Cottolene," which was to assume a position of major importance among cooking fats for many years. This product was likewise composed of cottonseed oil and oleostearin, usually in the ratios of about 80–85 and 20–15. Cottolene was yellow, deriving its color from the cottonseed oil. The use of a yellow oil lowered the cost of production because cheaper, unbleachable grades could be used. In addition to the compounds already mentioned, the N. K. Fairbank Company added six more shortenings to its list during the summer of 1888. One of these was registered early in 1889, the others not until 1901, 1903, and 1906.[3]

[1] Trade-mark No. 102,744, registered February 23, 1915. Patent Office files for 1906 disclose that the same company registered in that year the name Fairbank to cover lard and lard compounds produced, according to the record, continuously since 1868. It is the opinion of persons connected with the Patent Office that when two items, such as lard and lard compound, are mentioned, the presumption is that both were used from the time stated as the beginning of production, but that there is no certainty that this is the case. Lard alone may have been made in the beginning. In the case of the Fairbank trade-mark, the writers believe it very unlikely that a compound was produced and marketed as early as 1868. It is much more probable that pure lard was first produced, and that later various mixtures were introduced which were, in fact, compounds, but which were sold as refined lard, according to practices prevalent in the 'seventies and 'eighties.

Boar's Head Lard, produced by the N. K. Fairbank Company, and sold mainly as a bulk product, was originally a hog lard. During the 'eighties, some oleostearin, lard stearin, and later cottonseed oil were put in, but for a number of years it contained considerable quantities of hog lard—often as much as 60 per cent. Sometime during the 'nineties, it became a purely nonhog product. At times, Boar's Head Lard was hydrogenated (see p. 92), and continued as a bulk product until the liquidation of the American Cotton Oil Company, of which the N. K. Fairbank Company had been an integral part.

[2] Trade-mark No. 86,045, registered April 9, 1912.

[3] See Appendix D, pp. 284–85.

It is difficult at this date to determine definitely which of the various products registered at the Patent Office in the early years were actually marketed as lard substitutes, or lard compounds, and which were offered to the public as brands of refined lard, in spite of the Patent Office records of their character. We can be reasonably certain, however, that products with names, or trademarks, suggesting vegetable oils, such as Cottolene, Purola, Olive Butter, and the like, were never designed to be distributed to the trade as refined hog lard.[1] Accordingly, although many compounds unquestionably continued to be sold as lard, there were on the market in the late 'eighties, along with these brands of refined lard, a number of shortening products which were specifically presented to the trade as distinctive cooking fats and not as lard.

EMERGENCE OF THE NEW INDUSTRY

We are justified, then, in dating the beginning of the compound industry as an independent entity from the late 'eighties. This does not mean that the new industry emerged clear-cut and sharply distinct from the parent industry, lard refining, at that time. Some years were to elapse before the compounding of quasi-lard or non-lard shortening was clearly separated from lard refining in meat-packing establishments. But among cottonseed-oil refiners, particularly the two large organizations—the American Cotton Oil Company (successor to the American Cotton Oil Trust) and the Southern Cotton Oil Company, which together absorbed most of the major independent lard refiners and were participating in the shortening field in increasing volume—there can have been little or no pretense that they were engaged in the production of hog lard.

[1] "Cottolene . . . . is sold under its true name and not as lard": H. W. Wiley, *Foods and Food Adulterants, Part IV, Lard and Lard Adulterations* (U.S. Division of Chemistry Bulletin 13, 1889), 424, footnote.

In the decade of the 'eighties, compound came to constitute an important element in the cooking-fat market of the United States. It is impossible to measure its actual or relative importance with any approach to precision, because reliable data are lacking for lard as well as for compound, to say nothing of other cooking fats. The rate of increase is even more difficult to gauge, since much of the lard was more or less adulterated and compound was marketed under inaccurate and misleading labels.

Some significant evidence, though limited in scope and trustworthiness, is yielded by the Aspegren rounded estimates of the amount of cottonseed oil used for different purposes in the United States, and the uses of the exported oil, beginning with the cotton year ending August 31, 1875. According to these estimates,[1] the principal domestic as well as foreign outlets for cottonseed oil between 1875 and 1880 were in salad oil and soap making. Beginning with 1880–81, compound and margarine both made their appearance as outlets for domestically consumed cottonseed oil.[2]

A marked though somewhat erratic expansion in the decade is clearly indicated, and this broad fact may be accepted without question. Probably, however, the Aspegren figures understate the truth. In almost every year the total consumption accounted for by these estimates is more or less below the volume of cottonseed oil retained for domestic use, as calculated from production

[1] Presented in Tables II and III, and discussed more fully below, p. 63.

[2] Table II. For the decade in which lard compound first appears in these estimates, the percentages of the total cottonseed oil consumption used in lard compounds are:

Year	Percentage	Year	Percentage
1880–81	21.2	1885	35.8
1881–82	32.4	1886	39.8
1882–83	38.5	1887	43.9
1883–84	41.2	1888	40.8
1884–85	42.3	1889	46.5

and exports data (Table I). Moreover, in the Congressional hearings on the lard bill in 1890, a witness representing the N. K. Fairbank Company, and Armour and Company, stated that the former had sold 111 million pounds of compound in 1889.[1] He also estimated that his two clients together turned out 90 per cent of all compound cooking fats produced in this country. Three years earlier Mr. Armour stated that his company was using, in the manufacture of compound cooking fat, one-fifth of all cottonseed oil produced.[2] If one may assume that cottonseed oil constituted some 70 per cent of the total ingredients of compound at the end of the 'eighties,[3] it would appear that the N. K. Fairbank Company alone then used nearly as much of this oil for compound as the Aspegren estimates ascribe to the entire industry, and that about the end of the decade something like 130 million pounds of oil may have been used in compound, with a total compound output of over 180 million pounds. Since exports of compound were probably relatively small until later (see below, p. 96), it seems fair to infer that domestic consumption of compound late in the 'eighties was between 150 and 200 million pounds a year.

The only available data on lard production in this period are unofficial estimates that appeared in the *Cincinnati Price Current*.[4] These were apparently based on reports from the leading packers, and may perhaps be regarded as fair approximations to the factory output. These are summarized below, in million pounds, together with fiscal year export figures, the difference roughly representing domestic retention.

[1] *Oil, Paint, and Drug Reporter*, March 5, 1890, XXXVII, 27.

[2] *Ibid.*, March 9, 1887, XXXI, 6.

[3] The Armour formulas probably used a smaller proportion in these early years.

[4] Here taken from *Oil, Paint, and Drug Reporter*, April 9, 1890, XXXVII, 11.

Year	Production Nov.–Oct.	Exports July–June	Difference
1874–75	292	167	125
1875–76	305	168	137
1876–77	324	235	89
1877–78	445	343	102
1878–79	509	327	182
1879–80	505	375	130
1880–81	491	378	113
1881–82	400	250	150
1882–83	452	225	227
1883–84	420	265	155
1884–85	512	283	229
1885–86	519	294	225
1886–87	511	332	179
1887–88	475	298	177
1888–89	538	318	220

These figures of course exclude a large volume of lard that was produced on farms and by local butchers, for which there are no data, but which may have amounted to as much as the indicated factory output or more.[1] On the other hand, the output and net retention figures shown presumably include, at least until late in the 'eighties, a considerable though indeterminate amount of adulterated lard and compound. The table shows the amount of factory-refined lard retained for domestic use as averaging a little over 200 million pounds a year in the late 'eighties. We are thus led to the inference that, by the end of this decade, domestic consumption of compound had come to approach that of factory-refined lard, and to constitute perhaps 20 per cent of the domestic consumption of lard and compound combined.

[1] Assuming 500 million pounds for this production, the total lard consumption in the late 'eighties would seem to have been around 700 million pounds, or about 12 pounds per capita. This is not an unreasonable figure, and it corresponds closely to official estimates of per capita consumption for 1900–10. See Table IX.

CHAPTER II

EARLY ATTEMPTS TO CONTROL COMPOUND BY LEGISLATION

The fact that the compound industry was an outgrowth of lard adulteration has been made clear in the preceding chapter. This fact was in large measure responsible for subsequent efforts in legislative halls to subject the new industry to stringent regulation. The character of many of the proposed laws was such as seriously to threaten the future of compound as an independent and legitimate product. Consequently the protracted lard compound controversy in Congress, and in some state legislatures, played an important part in the early history of this industry.

Widespread Food Adulteration

The adulteration of lard was but one phase of the widespread practice of food adulteration which characterized the late decades of the nineteenth century. Those who sought to curb this evil were divided on the question of policy into two groups—one favoring general legislation covering all food products, and the other advocating limited legislation affecting specified commodities. The latter group included not only persons acting disinterestedly for public welfare, but also those who, for one reason or another, hoped to profit from restrictive laws on some particular industry.

During the 'seventies, adulteration of various foods, especially of dairy products, was being investigated by the United States Agricultural Commission (the precursor of the Department of Agriculture), by state boards of

health, by chemists in university and agricultural college experiment station laboratories, and by other agencies. As early as 1874, the United States Commissioner of Agriculture stated: "Considerable interest has recently been aroused regarding the use of animal fat in manufacturing artificial butter and in cheese."[1] The Commissioner perceived "the dangers of depreciation of quality and reputation attending the introduction of this new material into dairy manufactures."

For several reasons, attention was first effectively focused on the adulteration of butter and on butter substitutes rather than on lard. The growth to prominence of the margarine industry preceded by some years the extensive practice of lard adulteration. More important, however, is the fact that the dairy interests were very large, strong, and well organized,[2] and their grievance against margarine, either under the name of butter or under its own name, was a natural one. The issue appeared to be directly between agriculture and industry, although it did not take long for the defenders of the margarine industry to point out that the conflict was rather between different agricultural products.[3]

As is well known, the period after the Civil War was marked by a prolonged decline in commodity prices. Since the United States at that time was still predominantly an agricultural nation, falling prices of farm products were bound to create a nation-wide issue, even as they have in the recent period of much greater industrialization. Among the non-monetary causes for the downward trend in agricultural prices during the earlier period were the rapid expansion of railway transportation, the

[1] *Report of the Commissioner of Agriculture, 1874* (Washington, 1875), 254–55.

[2] The value of property invested in the dairy industry was exceeded by that of no other branch of agriculture.

[3] See Snodgrass, *Margarine as a Butter Substitute*, chap. iii.

extensive opening up and development of new, cheap lands in the Mississippi watershed, and the invention and improvement of refrigeration. One of the consequences of this westward expansion and of other developments was extensive abandonment of farms in the Northeast, especially during the 'eighties. Dairying was the chief pursuit and, one might say, the last hope of a great many farmers of the Northeast; to many of them the margarine question seemed a matter of life or death.

It was not easy, on the other hand, to interest farmers in the adulteration of lard, even after the existence of the practice had become common knowledge. As a matter of fact, the original opposition to the practice of mixing lard with other fats came from the packing industry itself. The drift of agriculture to new lands in the West was creating a crisis for the Eastern meat packers as it was for the Eastern dairy farmers. The opening of the campaign for legislation against lard adulteration marked one phase of the losing struggle of Eastern meat packers against the rising supremacy of some of their Western competitors.

This was the era of the beginnings of "big business," and the packing industry was one of the pioneers in exploiting the economies of large-scale operation. The smaller packers and butchers of the East found it increasingly difficult to compete with the vigorously growing establishments with headquarters at Chicago. The economic factors pushing the packing industry westward gave rise to the need of adequate refrigeration between production centers and markets. The development, in the late 'sixties and the early 'seventies, of the refrigerator car for the shipment of fresh meat gave the answer to this problem,[1] and it lessened one of the few disad-

[1] The first American patent for a refrigerator car was issued in November 1867; other patents involving different types of construction followed in the

vantages of Western packing establishments in competition with those of the East.

Now the extensive adulteration of lard with other fats was characteristic of Western lard producers rather than of Eastern ones. The development of special machinery and the utilization of chemical research naturally depended upon the growth of business units large enough to justify this type of expenditure. It was out of the question for small local butchers or other plants with limited output. The latter could, and doubtless frequently did, stiffen their lard with tallow or stearin when conditions called for it.[1] Other simple forms of adulteration, such as adding water, could likewise be practiced to a limited extent. But the developments which led directly to the establishment of the lard-compound industry occurred mainly among Western lard refiners.

The McGeogh Case and Its Aftermath

In 1881 a dispute arose out of a refusal to accept a shipment of lard because of "alleged adulteration."[2] The matter was investigated by a committee of the Chicago Board of Trade, which decided that "they could see no reason why the lard should not be received on contracts." Here the matter rested until two years later, when there occurred a dramatic episode in the history of the lard-refining industry. This brought the whole question of lard adulteration to a head, with results that extended beyond our national borders.

During the spring of 1883 Peter McGeogh of Milwau-

next few years, but satisfactory cars were not in use before 1875. R. A. Clemen, *American Livestock and Meat Industry* (New York, Ronald Press, 1923), 217–22. The first car of fresh beef was shipped from Chicago to Boston in 1869. *Report of the Federal Trade Commission on the Meat-Packing Industry, Part I* (Washington, June 24, 1919), 237.

[1] Such adulteration was even practiced on the farm for family use.

[2] See H. C. Taylor, *History of the Chicago Board of Trade* (Chicago, Robert O. Law Company, 3 vols., 1917), II, 635.

kee undertook to corner the lard market, and contracted in all for 150,000 tierces or more. The title "Lord of Lard" which he gained was, however, short-lived. On the first of June, he began to show signs of weakness by refusing to accept 1,000 tierces of lard of the James Wright and Company brand delivered by Fowler Brothers. He gave as reason for refusal the alleged adulteration of the lard in question. Although the lard had been inspected and passed, McGeogh laid the matter before the Provisions Inspection Committee of the Chicago Board of Trade.

This action of McGeogh attracted wide notice, particularly because attention was already focused on lard since the attempted corner had sent prices skyrocketing. The tone of a number of comments was in defense of Fowler Brothers, on the ground that lard adulteration was general and well known, and that some of the trade, especially that of Cuba, demanded it. The directors of the Board of Trade investigated promptly, and, though their sessions were secret, much of the testimony found its way into the daily press.[1] McGeogh maintained that Fowler Brothers, who controlled the Anglo-American Packing and Provision Company, had delivered as prime steam lard an article containing tallow, beef fats, cottonseed oil, and other substances.[2] A number of chemists, including some of the most distinguished of that time, testified in the hearings.[3] Several of them testified to the detection of tallow and other substances in various samples of lard examined within the past few years. The testimony, however, was more or less conflicting, and when 17 samples were submitted to five experts, there was no agreement

[1] Taylor, *op. cit.*, 671. [2] *Ibid.*, 673.

[3] Those examining samples and offering testimony included M. Delafontaine, a Swiss with a good European training, who taught science in the Chicago High School; J. M. Hirsch, also a trained chemist; William Hoskins, Walter S. Haines, Ira Remsen, R. A. Witthaus, and Stephen P. Sharpless. The last five are so well known to American chemists as to render comment regarding their standing superfluous.

among them in regard to the ingredients, or the quantities thereof, contained in the 17 samples. It thus became apparent that chemical methods for the detection of adulteration were not yet sufficiently developed to provide trustworthy evidence on the subject.

On August 22 the directors of the Chicago Board of Trade decided that the charges against Fowler Brothers were not sustained; at the same time, they took occasion to censure the firm for the use of "suspicious machinery and remarkable methods."[1] It is to be noted that the Board of Trade committee did regard the admixture in refined lard of fat from other sources than the hog as objectionable, for it expressed satisfaction that methods were being developed by chemists to detect as little as 10 per cent of adulteration.

The effects of the McGeogh corner and its aftermath were far-reaching. McGeogh himself was ruined, losing several million dollars as prices dropped sharply from May 7 to June 16, 1883, from $12.10 per hundredweight to $8.95. Thus was initiated a decline that persisted for several months (see Chart 2, p. 17). The exposures and publicity incident to the investigation proved damaging to the reputation of Chicago lard both at home and abroad. Undoubtedly, the shortage and high prices of lard in 1881–83 (see p. 18) had stimulated adulteration, especially with cottonseed oil, of which large quantities had recently become available. While it is apparent that the trade generally was fully cognizant of adulteration, it would seem that the practice had not previously been known to the public at large.[2]

Furthermore, beginning in 1879, as a result of increas-

[1] *McGeogh, Everingham and Company vs. Fowler Brothers. Charges, response, and evidence submitted and findings of the Board of Trade of the City of Chicago, August 1883* (Chicago, Knight and Leonard, 1883).

[2] Dr. S. W. Johnson, professor of chemistry at Yale in September 1880, gave a list of food adulterations which included "Lard, with boiled starch, alum,

ing knowledge concerning trichinae,[1] there had arisen agitation in Europe against American meat products, especially pork. This had led to wide restrictions on their importation. Germany, France, Italy, Austria-Hungary, and other countries had prohibited importation of various pork products from the United States. It was feared that this movement would spread and that, as a result of the disclosures of the McGeogh controversy, lard would be generally included among the prohibited products.[2]

The threat to our export market grew to such proportions that the President, on October 3, 1883, appointed a committee of five to report on the position of American pork products in foreign markets.[3]

Early Efforts toward State and Federal Legislation

So far as is known, the first definite legislation against adulterated lard was passed in Massachusetts.[4] In 1886 the legislature of this state passed a law compelling all mixtures of lard with other fats to be labeled compounds, instead of the names "refined lard" or "refined family lard," which had theretofore been employed to distinguish such mixtures from prime steam lard, the contract lard of commerce. The legislatures of Illinois and Maine

---

and quicklime," but made no mention of tallow or cottonseed oil (*House Reports*, Vol. 1, No. 199, 1880–81, p. 5 [46th Congress, Third Session, Serial No. 1982]).

[1] A minute parasitic worm encysted in the flesh and organs of hogs. Such pork is sometimes described as "measly." If these worms are not killed either by heat in cooking or by holding the meat for some time at low temperatures, consumption of the meat may cause a serious disease in man known as trichinosis. Trichinae were discovered by Sir James Paget in 1835, but it was not until 1860 that the clinical characteristics of the acute disease were discovered by Friedrich von Zenker.

[2] *Senate Reports*, Vol. 3, No. 345, 1883–84, p. 4 (48th Congress, First Session, Serial No. 2175). Austria-Hungary, in its decree of March 10, 1881, prohibiting the importation of swine meat from the United States, included lard.

[3] *House Executive Documents*, Vol. 26, Part I, No. 106, 1883–84, p. 6 (48th Congress, First Session, Serial No. 2206).

[4] Clemen, *op. cit.*, 365.

followed with "stringent laws" against the sale of adulterated lard.[1] By the year 1888 a large number of states had passed laws prohibiting the adulteration of food and drugs, but in general these laws were not considered capable of enforcement.[2] The effectiveness of state laws was further reduced by the "original package" decision of the United States Supreme Court, in April 1890, which enunciated the principle that the states did not have the power to interfere with the objects of interstate transportation when in their original packages.[3]

At the opening of the 50th Congress in December 1887, a number of petitions were presented from interested groups urging the passage of legislation restricting lard adulteration. The first petitions came from the Butchers' National Protective Association and several of its local branches. These were shortly followed by similar messages from the Cincinnati Chamber of Commerce, the Cincinnati Pork Packers' Association, and other organizations. On December 13, 1887, by request of John P. Squire, a packer of Cambridge, Massachusetts, Senator Dawes of that state introduced in Congress a bill (*S. 650*) "to protect the manufacture and sale of pure lard." In the following month, Representative Butterworth of Cincinnati introduced a bill (*H.R. 6183*) "to regulate the manufacture and sale of counterfeit or compounded lard." Another bill introduced by Representative Butterworth soon followed. The House bill was sponsored by the pork packers of Cincinnati.

While the first petitions to Congress were all from persons or groups antagonistic to compound lard, the Southern cottonseed-oil interests were not slow to take

[1] A. J. Wedderburn, *A Popular Treatise on the Extent and Character of Food Adulterations* (U.S. Division of Chemistry Bulletin 25, 1890).

[2] *House Reports*, Vol. 10, No. 3341, 1887–88, p. 8 (50th Congress, First Session, Serial No. 2607).

[3] *Leisy v. Harden*, 135 U.S. 100.

up cudgels in defense of this product. By February 1888 memorials began coming in from various parts of the South, protesting against the proposed legislation and against all taxation or suppression of lard mixed with cottonseed oil. Before the end of spring, petitions and memorials on both sides of the question, aggregating several hundred and from three-fourths of the states of the Union, had been received in Washington.

Acting on a resolution introduced in March 1888 by Representative Baker of Illinois, the House Committee on Agriculture, to which the Butterworth bills had been referred, conducted hearings on the lard controversy until early summer. On July 28, 1888, as a result of these hearings, the committee submitted a report[1] and offered a new bill as a substitute for the Butterworth bills. This bill (*H.R. 11027*) was known as the Conger bill, having been reported from this committee by Representative Conger of Iowa. In general, it followed the pattern of the oleomargarine bill passed by Congress in 1886, in that it aimed at regulation through taxing the manufacture and sale of compound lard. It also required the "branding of mixtures or compounds that are made in semblance of and sold as lard, so that the purchaser of such compounds may be advised of the real nature of the article he purchases."

The report accompanying the Conger bill stated that various compounds were sold at home and in foreign markets under the names "refined lard, or refined family lard," etc., which contained other ingredients, chiefly cottonseed oil and beef stearin. The committee received testimony from a Board of Trade witness to the effect that more lard left Chicago than could be accounted for by local production and receipts. This excess was esti-

[1] *House Reports*, Vol. 8, No. 3082, 1887–88, p. 1 (50th Congress, First Session, Serial No. 2605).

mated to have been 12 million pounds as early as 1882 and 73 million pounds in 1886.[1] "The same thing," according to this report, "was occurring at Kansas City, St. Louis, Louisville, Cincinnati, and New York." The report emphasized the fact that lard was more expensive than the other two main articles used in these compounds, which, therefore, could be made and sold at lower prices and thus drive the pure article out of the market.

John Hately, a member of the Chicago Board of Trade, testified that, according to his calculations, the adulteration of lard in this fashion reduced the value of each hog received in Chicago by 32 cents.[2] The annual loss to hog-raisers he calculated, on the basis of the 1886–87 slaughter, at from 13 to 15 million dollars, or close to double the value of the entire cottonseed-oil production.[3] Hately also testified that from 55 to 70 million pounds of lard, or what purported to be lard, were shipped from Chicago in 1886 in excess of the aggregate of the quantities shipped into the city and produced therein. He asserted that Armour and Company alone was using over 28 million pounds of cottonseed oil annually, and that the N. K. Fairbank Company used more than Armour.[4] The report likewise pointed out that an enormous foreign trade in lard was being damaged by the deceptive practice of exporting under misleading names.

[1] These figures were derived from the following estimates:

Year	Received in Chicago	Made in Chicago	Total	Shipped from Chicago	Excess of shipments
1882...........	40	183	223	235	12
1886...........	88	149	237	310	73

[2] Hately's estimate was based on the assumption that lard should sell for one cent more than short ribs. During the season 1886–87 the two sold at the same price; hence his contention that the farmers were losing one cent per pound on each hog.

[3] See below, p. 52, for a criticism of this contention.

[4] *House Reports*, Vol. 8, No. 3082, 1887–88, p. 3 (50th Congress, First Session, Serial No. 2605).

There was no minority report against this bill, but the report of the hearings indicated that the friends of compound lard were by no means without representation. The majority report sums up the arguments of the defenders of "this stupendous commercial fraud"[1] by manufacturers of these compounds, as follows:

> . . . . They claim that they are producing a new and wholesome article of food; that the consumers are satisfied with it; that in point of fact it is better than lard, and they claim that they have the right to manufacture these compounds with such a quantity of lard in them as they choose to put in, and with just as much of the other ingredients as they choose to use, and that so long as the consumers make no complaint in respect of this, nobody else has any right to complain, and that what they are doing in this regard is perfectly legitimate and proper.

The majority report undertook to answer these points, but its arguments may be boiled down to the simple, relatively unassailable position that "there can be no justification of the attempt to build up one industry (cottonseed oil) by using the name of another (lard) to give the former a market and an additional value" at the expense of the latter.[2]

It is interesting to observe that those advocating the passage of the Conger bill in this report did not undertake specifically to answer, or even to give particulars concerning, the third point listed above in defense of compound lard. The reason is not far to seek. The counterattack launched by the opponents of the bill consisted of some very damaging testimony on practices in plants manufacturing so-called "pure" lard. They alleged that conditions in such plants were appallingly unsanitary and that so-called pure lard was anything but pure in the sanitary sense. Testimony was submitted to the effect that white grease—an inedible product—had practically

[1] *House Reports*, Vol. 8, No. 3082, 1887–88, p. 4.
[2] *Ibid.*, 5.

ceased to be produced in these packing houses; that hogs fed on swill and distillery grains formed a large percentage of those that were killed and packed; that many diseased animals were used; and that "piggy" sows were put into the lard tanks, etc. The testimony of a Mr. Barthels was particularly effective. He was a retired packer of St. Louis who had, however, leased his plant to the American Cotton Oil Company, and so may naturally have been well disposed to the lard-compound interests. An employee of the Squire plant in Boston, the owner of which was back of the original Dawes bill in the Senate, testified that in making pure lard, pig heads and feet, rough lard, and white grease were used; that there was hair on the heads and hoofs, and toes on the feet; and that white grease was made from guts and paunches.

On the whole, the sensational testimony offered put the packers advocating this bill in a very uncomfortable position, and friends of cottonseed oil freely expressed elation that the campaign against their product seemed destined to prove a boomerang to those who had launched it. In fact, it was more than once suggested that cottonseed oil suffered from association with lard, and that producers of the former would do well to market their product independently, as a non-hog shortening. This they were destined ultimately to do.

No action was taken in this session or in the short session that followed, on either the House or the Senate bills, and the 50th Congress expired without passing on the question of compound lard. Likewise, no action was taken on a general food adulteration bill which was introduced into the House during the first session of this Congress, and on which a report was rendered by the House Committee on Agriculture.[1]

[1] *H.R. 10320*, June 4, 1888, 50th Congress, First Session; later supplanted by *H.R. 11266*, reported back August 25, 1888, 50th Congress, First Session. See

British Prosecution of Misbranding

While the hearings on lard adulteration were being held, there took place in England a development which diminished some of the force behind the movement for restrictive legislation against compound lard in the United States. Great Britain had had a "pure food" law since 1875, which required the accurate labeling of products. Under this law, several dealers were tried in 1888 for selling adulterated lard imported from the United States. A British chemist, Dr. Campbell Brown, had undertaken the analysis of some American lard, beginning in 1886. At the trial nearly two years later he testified that he had conclusively proved that the lard in question contained about 40 per cent of foreign matter, mainly cottonseed oil and beef or mutton stearin. The dealers were convicted and fined, and other convictions for the same offense followed in other parts of Great Britain. The publicity given to lard adulteration in the United States by the McGeogh corner is said to have inspired the first analysis of lard in England, while the widespread petitions and memorials to Congress on the subject, as well as the Congressional hearings in the spring of 1888, probably had much to do with bringing the matter before the British courts. At any rate, on June 20, 1888, the Liverpool agents of Armour and Company began distributing labels for use on Armour's refined lard which stated that "this product is mixed."[1] The N. K. Fairbank Company, the other large American manufacturer of refined or compound lard, followed soon after with an announcement to the effect that henceforth all products formerly sold as refined lard would be branded "refined lard

---

also *Congressional Record*, Vol. 19, June 4, August 25, 1888, pp. 4888, 7953; *House Reports*, Vol. 10, No. 3341, 1887–88 (50th Congress, First Session, Serial No. 2607).

[1] *House Reports*, Vol. 3, No. 970, 1889–90, Part 1, p. 30 (51st Congress, First Session, Serial No. 2809).

compound."[1] This satisfied the requirements of the British law, and at the same time met the objections of many of those advocating legislation on the subject in the United States.

Federal Investigations of Adulteration

During this time, the Division of Chemistry of the United States Department of Agriculture had been engaged on a series of investigations of food adulteration under the late Dr. Harvey W. Wiley. The fourth report in this series, which dealt with lard and lard substitutes, appeared in February 1889, shortly before the end of the second session of the 50th Congress. On the question of the prevalence of the practice of mixing lard with other animal and vegetable fats, the report expressed no doubt. Regarding the manner in which the public was affected by this practice, the report has the following to say:[2]

> . . . . It is hardly necessary to call attention, however, to the fact that the stearines and cotton oils used in the manufacture of adulterated lard are, so far as known, perfectly wholesome and innocuous. There is every reason to believe these are fully as free from deleterious effects upon the system as hog grease itself.
>
> A more serious question which is presented is the effect of selling adulterated lard as pure lard or refined lard. To do this is a fraud upon the consumer. Although it has been claimed by the large manufacturers of refined lard that the term refined is a trade-mark whose meaning is perfectly well known by seller and purchaser, yet it can not be denied that the meaning of the word refined in the above sense is generally unknown to the consumer. The idea conveyed to the ordinary consumer by the word refined would be an article of superior purity for which he would possibly be willing to pay an increased price. It is gratifying to know that since the investigations recorded above were commenced the largest manufacturers of compound lard in this country have decided to abandon the use of the term refined and to sell their lards as compound lard or lard compounds, and, in cases where no hog grease at all enters the composition of the article, to place it upon the market as cottolene or cotton-seed oil product . . . .

[1] *Ibid.*, Part 2, p. 17.
[2] Wiley, *op. cit.*, 547.

The extensive adulteration of American lards has afforded grounds to foreign countries for prohibiting importation of our production or of levying upon it a heavy duty. By requiring all food products made in this country to be labelled and sold under their true name we could secure for our products immunity from any such exclusion from foreign countries as is mentioned above. The right of foreign countries to levy an import duty on our products is one which we would in no measure seek to abridge; yet by the recognized purity of our exported food articles we should see that they secure a proper entrance into foreign countries. These remarks are not alone applicable to lard and its adulterations, but to all kinds of food products, whether they are to be consumed at home or abroad.

Renewed Demands for Legislation, 1889–90

In spite of these findings, and the fact that the largest producers of compound lard were presumably now labeling their product as such, the agitation for some form of restrictive legislation was renewed in the 51st Congress, which convened in December 1889. Representatives Conger and Butterworth reintroduced their bills into the House,[1] substantially as before, while Senator Dawes did likewise in the Senate.[2] Once more the Committee on Agriculture reported favorably on the Conger bill, accompanying it by a report which was largely a reproduction of the report on the similar bill in the preceding Congress.[3]

By this time, however, the support of Western farmers had been solicited on the ground that lard adulteration was partially responsible for the prevailing low prices of hogs and lard. Eastern farmers were not particularly concerned over the question. Dairy interests, very important

[1] *H.R. 283*, December 18, 1889, and *H.R. 679*, December 18, 1889, 51st Congress, First Session. See also *Congressional Record*, Vol. 21, Part 1, December 18, 1889, pp. 235, 249.

[2] *S. 2344*, January 27, 1890, 51st Congress, First Session. See also *Congressional Record*, Vol. 21, Part 1, January 27, 1890, p. 856.

[3] *House Reports*, Vol. 3, No. 970, 1889–90, Part 1 (51st Congress, First Session, Serial No. 2809).

in the agriculture of the East and parts of the Northwest, had fought and won their fight four years earlier, when they secured the passage of the Oleomargarine Act. The problem of compound lard did not affect or concern most of them to any extent. On the other hand, with prices of most pork products out of line with other meat products, the Midwestern hog-producing farmers were naturally on the alert to favor any movement promising, however rashly, to improve prices of their product.

The increased emphasis on the agricultural phase of lard adulteration is evidenced by the fact that the objects of the proposed legislation, as outlined in the report to the 50th Congress,[1] stressed fair competition and the interests of the consumer; whereas, the report on this bill to the 51st Congress listed also, as an object, aid to the farmer in the then prevailing agricultural depression "caused in part by the displacement of a large and increasing amount of the pure fat of the hog by a spurious substitute . . . ."[2] Otherwise, this last-mentioned report is similar to the report of the preceding Congress.

On this occasion, however, the bill was accompanied by a minority report submitted by Representative McClammy of North Carolina. The minority report took decided exception to the position of the majority and opposed the bill on many grounds. Among other things, it declared the bill created an invidious discrimination against a part of an industry at the demand of other branches of the same trade which are conducted in a manner more objectionable and more obnoxious to the public. It likewise asserted that the passage of this bill would drive lard compound out of the market and strike a heavy blow at the cotton growers of the South by lessen-

[1] *House Reports*, Vol. 8, No. 3082, 1887–88, p. 1 (50th Congress, First Session, Serial No. 2605).

[2] *House Reports*, Vol. 3, No. 970, 1889–90, Part 1, p. 1 (51st Congress, First Session, Serial No. 2809).

ing the demand for cottonseed oil. The bill was declared bad for the following reasons:

1. It would "increase the price to consumers of a wholesome and necessary food product."
2. It discriminates in favor of one manufacturer against another.
3. It would injuriously affect "the agricultural interest of cotton growing."
4. It prescribes unprecedentedly severe penalties for its infringement.
5. It seeks "to regulate the manufacturers of 'lard compound' at the solicitation of manufacturers who are themselves in greater need of regulation."[1]

The minority report likewise denied that the bill would benefit the farmers. It argued that the general agricultural situation, along with the volume of corn and hog production, was responsible for low pork and lard prices; and that the use of cottonseed oil in compound lard had virtually nothing to do with the matter. In reply to the accusation that the production of compound lard depressed the price of lard by increasing the supply of products going into consumption as lard, the following statement is made in the minority report:[2]

> While compound lard has absorbed a large quantity of beef fat and cotton oil in its manufacture, it is to be remarked that in the production of imitation butter a large quantity of lard has gone into consumption otherwise than as lard, thus balancing in a considerable degree the accretion to the lard supply by the additions of mixtures in the manufacture of lard compound.

On the question of deception of the public by misbranding, this minority report mentioned the action of the leading manufacturers in adopting in 1888 the word compound, and so branding their goods. It was estimated that

[1] *House Reports*, Vol. 3, No. 970, 1889–90, Part 2, p. 7.
[2] *Ibid.*, 28.

90 per cent of this product was now being so labeled,[1] and that the expenses incident to resuming the practice of misbranding, now that it had largely been given up, would preclude the manufacturers from reverting to it.

Finally, the position taken in the minority report was that a bill of this character should cover the entire lard industry and the process of manufacture from beginning to end. Mr. McClammy had introduced two such bills into the House, offering them as a substitute for the Conger bill.[2] They took the form of the latter with only such additions as to make them include the packer and slaughterer as well as the manufacturer of compound lard, and were designed to regulate the manufacture and sale of all cooking fats.

The appendix of this minority report contains, among other data, the reports of the New York and New Hampshire State Boards of Health, whose favorable accounts of the wholesomeness of lard compound put an end to the proposal for similar legislation in those states. It contains also a chart showing the relationship of the size of the corn crop and of corn prices to hog prices, and certain evidence from the testimony at the hearings before the committee not quoted in the majority report. This evidence bore on the subject of unsanitary practices among packers of pure lard, including the use of white grease, washed guts, and smothered and diseased hogs.

Representative J. H. Wilson of Kentucky also submitted a minority report, disapproving the Conger bill (*H.R. 283*) and endorsing the McClammy bill.[3] Wilson took special occasion to deny the contention of many supporters of the

[1] Referring evidently to the production of the N. K. Fairbank Company and Armour and Company.

[2] *H.R. 7177*, February 18, 1890, and *H.R. 7346*, February 24, 1890 (51st Congress, First Session). See also *Congressional Record*, Vol. 21, Part 2, February 18, 24, 1890, pp. 1468, 1666.

[3] *House Reports*, Vol. 3, No. 970, 1889–90, Part 3 (51st Congress, First Session, Serial No. 2809).

bill that lard compound was injuring the farmer, or that the proposed bill would safeguard his interests. He attacked the calculations of John Hately that hog farmers were losing from 13 to 15 million dollars because of the competition of compound lard with pure lard. He pointed out that of the 32 pounds of lard per hog, nine pounds consisted of leaf fat, and this had been disposed of for a number of years to margarine manufacturers at 2 to 3 cents per pound above the prevailing prices of prime steam lard. Deducting the leaf fat from the total fat per carcass left only 23 pounds on which the alleged loss of one cent per pound could take place. The gain from leaf fat sales (9 pounds at 2½ cents per pound, or 22.5 cents), however, virtually canceled even this problematic loss, leaving the farmer unaffected. Wilson further undermined Hately's contentions by pointing out that the latest quotations on lard showed it to be again selling at one cent per pound above the price of short ribs, the temporary disappearance of which price differential had been the basis of the latter's estimate. He also drew attention to the work of the Bureau of Statistics of the United States Department of Agriculture, which showed the dependence of hog prices on corn prices, and explained the high pork prices of 1882 on the basis of the corn crop failure of 1881. It was Wilson's contention that the proposed bill (*H.R. 283*), instead of benefiting the farmer, would injure him in at least three ways:[1]

1. By leaving the pork packers entirely unregulated and free to render whole hogs and inedible refuse, it "limits the sale and depresses the price of his home-made lard," which can be made from only the suitable parts of the animal.
2. "It degrades the standard of American lard, to the injury of our foreign commerce."
3. "It transforms into so-called 'lard' those portions of the animal which ought to be thrown away or sent to the glue factory," thus increasing the supply of lard on the market.

[1] *House Reports*, Vol. 3, No. 970, 1889–90, Part 3, p. 5.

This report heartily endorsed the McClammy bill and emphasized the importance of putting manufacturers of all kinds of lard under the supervision of the United States government.

Late in the first session of the 51st Congress, Representative Brosius of Pennsylvania reported[1] on *H.R. 11568*, which the Committee on Agriculture had offered as a substitute for the Conger bill. These two bills were the same except for minor changes. In a discussion of the new bill on the floor of the House, Brosius was moved to the following eloquence:[2]

> These manufacturers with unabashed foreheads and shameless cheek continued to sell this counterfeit as the sound coin of the realm until 1888, when a diminished market for pure lard and for the farmers' swine revealed the ravages this spurious commodity was committing upon the honest domain of agriculture. The farmer and manufacturer of lard, and consumers at the mercy of counterfeiters, were seized with alarm. Dismay spread like a cry of fire. The people assembled, consulted, and debated until a tide of indignation rose that carried the representatives of the people upon its swelling flood, until a bill was on the Calendar of Congress to suppress the fraud, arrest the ravages to farm and factory, and strike the mask of truth from the face of falsehood.

Many representatives from the South, and some from other parts of the country, spoke against the bill, often with equal vehemence. Most of them tried to establish the fact that it was the pork packer and not the farmer who was behind the bill, and that the practices of the former were more in need of supervision than were those of lard compounders. Some urged different legislation, either along the line of the McClammy bill, or a general measure covering all food products.

On August 28, 1890, the bill was passed by the House by a vote of 126 to 33, with 167 members, including a large

[1] *House Reports*, Vol. 9, No. 2857, 1889–90 (51st Congress, First Session, Serial No. 2815).

[2] *Congressional Record*, Vol. 21, Part 9, August 4–28, 1890, p. 8898 (51st Congress, First Session).

number of Southern representatives, not voting.[1] The Senate referred this bill to the Committee on Agriculture and Forestry, but took no further action upon it. In fact, the lard controversy never became active in the upper house. The two bills introduced by Senator Dawes of Massachusetts, one in the 50th and one in the 51st Congress, are the only Senate bills on record which refer exclusively to lard compound until the Wilson bill of 1892 (see below, p. 57). Neither appears to have been reported out of the committee to which it was referred, so that no discussion took place on the floor, although the committee did hold hearings.

Other Food-Control Bills

The Senate was not inactive during this time, however, on the subject of more general legislation concerning food, and a number of bills were considered which covered a wider field than that of lard adulteration. Of two bills introduced in the Senate, in the 51st Congress, one included the entire field of manufacture, import, and export of all products intended for human consumption, and the other covered only the inspection of meats for export.[2]

The general pure food bill as introduced was reported unfavorably, and a substitute was offered which was known as the Paddock bill. This bill, according to the report accompanying it, was designed "to provide for the inspection of, and to prohibit the introduction of, adulterated or misbranded foods or drugs into any State, or Territory, or the District of Columbia, from any other

[1] *Congressional Record*, Vol. 21, Part 9, August 4–28, 1890, p. 9278.

[2] The first was *S. 279*, December 4, 1889, 51st Congress, First Session, later amended in committee and reported out as *S. 3991*, reported June 3, 1890, 51st Congress, First Session; the other was *S. 2594*, February 11, 1890, 51st Congress, First Session. See *Congressional Record*, Vol. 21, Part 1, December 4, 1889, p. 102; Part 6, June 3, 1890, p. 5517; and Part 2, February 11, 1890, p. 1193 (51st Congress, First Session).

State, or Territory, or foreign country, and to provide, through the Department of Agriculture, proper administrative machinery for its enforcement."[1] The report urged the passage of this bill on the ground of protection to the farmer and the consumer, and for the restoration of the good reputation of American food products abroad damaged by the disclosures of recent years.

A minority report submitted by four Southern members opposed the Paddock bill on the grounds that it could not be effectively enforced because of the lack of development of analytical chemistry; that it would increase bureaucracy and patronage; that this function had better be left for action by the individual states; and finally, that it was merely another phase of the lard struggle. In view of the large amount of space devoted to the defense of compound lard and cottonseed oil in the minority report, it may reasonably be inferred that the real reason for the opposition to the bill by the Southern senators came from a fear that compound lard would be among the first articles attacked if the bill became law.

Failing to get his bill before the Senate for discussion, Senator Paddock endeavored to have it appended to the agricultural appropriation bill in the second session; but this attempt failed, and the bill did not come up for action during the 51st Congress.

On the other hand, a bill (*S. 2594*), introduced in the Senate February 11, 1890, providing for inspection of meats for export, met little opposition. The widespread restrictions imposed against American meat products in Europe, subsequent to disclosures of improper packing methods, lent force to the movement to restore, so far as possible, our lost foreign markets. Since this bill covered only the inspection of meats intended for export and pro-

[1] *Senate Reports*, Vol. 8, No. 1366, 1889–90, p. 1 (51st Congress, First Session, Serial No. 2710).

hibited the importation of adulterated foods, liquors, and drugs, little domestic opposition developed. It passed both houses quickly and became a law on August 30, 1890.[1]

The enactment of this law removed part of the impetus behind the lard-compound bill, since one of the commonest grounds for urging the latter was the disrepute into which American pork products had fallen in foreign countries because of adulteration and unregulated methods of production.

Final Efforts to Secure Federal Legislation, 1892–93

Nevertheless, the agitation on the subject of lard compound as well as on food adulteration in general was continued in the 52d Congress. Hundreds of petitions were forwarded to Congress in the winter and early spring of 1892. As before, the regional character of the controversy was demonstrated by the almost uniform opposition of the Southern communities to such legislation, and the support of the Middlewestern and a few Eastern states. Some support for a general food adulteration law was, however, also received from certain Southern groups.

On January 7, 1892, Representative Brosius of Pennsylvania, who had been an earnest advocate of the Conger bill in the preceding Congress, introduced a bill (*H.R. 395*)[2] quite similar to the Conger bill "defining 'lard' and imposing a tax on manufacturers of compound lard." Brosius did not succeed in having his bill referred to the Committee on Agriculture, as had been done with similar bills previously. The Speaker *pro tem.* ruled that it involved the question of revenue, and so belonged to the Committee on Ways and Means. In this committee, as Brosius was well aware, his bill stood small chance of a

[1] See 26 Stat., 415; *Congressional Record*, Vol. 21, Part 10, August 30, 1890, p. 9388 (51st Congress, First Session).

[2] See *Congressional Record*, Vol. 23, Part 1, January 7, 1892, p. 198.

favorable report, or indeed of receiving any attention at all. Senator Wilson of Iowa likewise introduced a compound bill in the Senate[1] in April 1892, which was similar to the Brosius bill in title and content. The Senate bill was referred to the Committee on Agriculture and Forestry. The fate of both bills was the same. They died in committee, and with them the last attempt in Congress to tax lard compound separately. That no other bill was again presented to Congress in the following years was due no doubt to the coming in power of a Democratic administration in which Southern Congressmen, unfavorable to this type of legislation, had great influence.

The threat to cottonseed oil contained in the various lard-compound bills before Congress during the greater part of five years (1888 to 1892) was an important factor influencing the course of general food-adulteration legislation in this country. The far-reaching economic effect of a general pure-food bill was bound to arouse more or less conflict between localities whose diverse activities would be unequally affected by such legislation. Nevertheless, there is good reason for the belief that the cotton-raising South was aroused to a more unified opposition to the several food-adulteration bills introduced in the early 'nineties than it would otherwise have displayed had not the long and acrimonious debates over lard-compound bills engendered an abnormal sensitiveness toward anything that might be construed as a menace to one of its most important and rapidly expanding industries. Support for this view appears in Congressional debates and reports on the Paddock bills in the 51st and 52d Congresses.

The later Paddock bill was easily passed by the Republican Senate on March 9, 1892, but only over the oppo-

[1] *S. 2984*, April 22, 1892, 52d Congress, First Session. See also *Congressional Record*, Vol. 23, Part 4, April 22, 1892, p. 3515.

sition of a number of Southern senators. Although this bill was favorably reported out of the House committee to which it had been referred, the Democratic House permitted no consideration in open session. It seems reasonable to believe that the widespread desire among virtually all classes of people throughout the United States at that time for the restriction of food and drug adulteration would have led to the enactment of the Paddock bill had not many in the South interpreted it as a disguised attack on the cottonseed-oil industry by a hostile North. The reconstruction period after the Civil War, with the attendant political impotence of the South, was not far enough in the past to enable those states to view calmly any act which might retard their economic rehabilitation. They still resented the wartime measures taxing the manufacture of alcohol and alcoholic beverages as discriminatory and exceeding the powers conferred by the Constitution. They naturally regarded the Oleomargarine Act of August 2, 1886, and the Conger bill as further extensions of what they viewed as the pernicious interference of the federal government with the sovereignty of the states. It was not until June 30, 1906, that Congress finally passed the Food and Drugs Act (34 Stat., 768), which dealt with the whole problem of food adulteration and misbranding.

CHAPTER III

THE INDUSTRY FROM 1890 TO THE WORLD WAR

By 1890 the compound industry had emerged from infancy into lusty youth. Soon after, it finally succeeded in escaping strangulation or serious handicap which the agitation for control legislation had threatened. In the twenty-five years that elapsed before the outbreak of the World War, the industry progressed irregularly from youth to maturity. In 1914 the total output of compound, according to one of the earliest comprehensive estimates, was some 1,137 million pounds (Table X). This was six or seven times as large as the rough approximation we have reached for the output late in the 1880's (see above, p. 32). Some such notable expansion undoubtedly occurred. The level reached in 1914 has not since been greatly exceeded, except perhaps in 1919.

Reasons for Paucity of Data

Particularly during the 'nineties, the compound industry fails to stand out in clear relief from the environment in which it was developing. This is not surprising even though by 1890 the output was produced mainly by meat packers and cottonseed-oil refiners, and chiefly by a small number of these. A large variety of products, varying in ingredients and proportions used, were turned out and sold as lard, lard mixtures, or lard substitutes containing no lard. The producers were free to turn out any or all of the several kinds of shortening simultaneously. They undoubtedly varied their practice to take advantage of changing relations of supplies and prices of the different raw materials, and to satisfy the changing demand

with the most satisfactory relation of product prices to costs.

Lard adulteration continued after the governmental investigations already discussed, but to what extent no one can ascertain. The premium which lard commanded, and its established reputation with consumers, offered a temptation to producers to increase their volume of lard by as much adulteration as they felt safe in attempting.[1] It is not even certain that Armour and Company and the N. K. Fairbank Company, who in the late 'eighties were said to account for about 90 per cent of all lard compound produced for sale, fully lived up to the policy they announced in 1888 of labeling correctly all mixtures they produced. It seems certain that numerous smaller producers continued to market adulterated lard as refined lard rather than as lard compound during the 'nineties. It is significant that only shortly before the end of the century (according to a personal statement made in 1930 to one of the authors), the leading Chicago packers reached an agreement to discontinue lard adulteration and misbranding.

Before 1890 Massachusetts, Illinois, and Maine had passed laws requiring appropriate labeling of lard mixtures. By 1900 seven other states[2] and the District of Columbia had passed laws containing special provisions regarding lard adulteration, in most cases requiring correct labeling. Most of the states and territories had legislation[3] of some sort prohibiting the manufacture and sale

[1] Regular price quotations on lard compound do not make their appearance in the *Oil, Paint, and Drug Reporter* until the beginning of 1897. During that year, lard prices were abnormally low, so that the differential above lard compound was very slight. Earlier years were doubtless characterized by margins considerably wider and more tempting to lard adulteration, and so again were the years following 1897.

[2] Iowa, Kentucky, Michigan, Minnesota, Pennsylvania, South Dakota, and Vermont.

[3] For a digest of these laws, see Senate Documents, 1901, Vol. XI, No. 141 (Serial No. 4039), 154–97.

of adulterated foods in general. Federal legislation was delayed until 1906. Nevertheless, the enforcement of such laws was beset with difficulties, among them the imperfection of methods of detecting such adulteration.

Throughout the 'nineties and into the earlier years of the twentieth century, various state and federal investigations of food adulteration were being made. Many of these naturally included lard within their scope. Professor Edward H. Jenkins of Yale, in charge of examination of food products for Connecticut, testified about 1900 before the Senate Committee on Manufactures that, among 162 samples of lard examined at the Connecticut Agricultural Station, 36 were adulterated with cottonseed oil and beef stearin. It is to be presumed that none of these 36 samples bore labels to indicate that they were compounds. He testified before the same committee that, in addition to the lard substitutes sold as such, more than one-fifth of the products on the market sold as lard contained some cottonseed oil and beef stearin.[1]

Among state reports on the subject of food adulteration which published findings of extensive adulteration of lard with cottonseed oil or beef stearin, or both, are the following: Ohio Dairy and Food Commission Report, 1895; Connecticut Experiment Station Reports, 1896, 1900; New Jersey Dairy and Food Commission Report, 1898; Massachusetts State Board of Health, 1899–1900; North Carolina State Board of Agriculture Bulletin, 1900; Minnesota Dairy and Food Commission Report, 1901.

It is fair to conclude that the marketing of adulterated lard or lard compound under the guise of refined lard, alongside similar products correctly labeled, continued in an indeterminable though probably decreasing volume

[1] *Senate Reports*, Vol. 3, No. 516, 1899–1900, p. 451 (56th Congress, First Session, Serial No. 3888), to accompany *S. Res. 447*, May 6, 1898 (55th Congress, Second Session).

into the new century. Many producers evidently still preferred to take their chances with regulatory laws, where these existed, rather than attempt to educate the public to the merits of a new type of shortening. Moreover, it was chiefly as a cheaper substitute for lard that compound consisting mainly of vegetable oils was marketed.

Under the circumstances discussed, usable statistics of such diverse products could not readily have been compiled until after 1900, and neither the government nor the trade made attempts in this direction until after the passage of the Federal Meat Inspection Act of 1906. The administration of this act yielded some fairly reliable data beginning with the year ending June 30, 1908, but only for compounds produced under federal inspection. The first Census of Manufactures to collect data in this field was that of 1914, but it gave quantity figures for the meat-packing industry only, and even these were apparently not comprehensive. The first comprehensive estimates, for 1912 and 1914, were compiled from data gathered by the Fats and Oils Division of the Food Administration in 1917 and 1918.[1] The estimate for 1912 seems open to some question, but that for 1914 checks fairly well with a quantity figure derived from the Census of Manufactures figure for value of product and the average price for the portion produced by the meat-packing industry.

Lacking trustworthy statistics for the industry prior to 1914, we cannot trace its somewhat irregular progress year by year with any close approach to accuracy. Nevertheless, much light can be thrown on its development by a critical use of relevant trade estimates, opinions, and price quotations, such official data as are available, and pertinent aspects of the financial and economic history of

[1] These data are given in Table X and are in part graphically presented in Chart 5, p. 92.

the period; and by considering the economic and technological problems that the industry faced and partially solved in this period.

Indications of the Course of Production

Perhaps the best single indication of the course of compound manufacture in this period is afforded by the Aspegren estimates of cottonseed oil used in its manufacture. Aspegren and Company were important New York brokers in cottonseed oil who became factors and then manufacturers of compound. The firm was thus in intimate touch with the industry, and in a position to make trustworthy estimates if anyone could. Moreover, these estimates were first made when the decade of the 1890's was just past, and they were continued during the early years of the new century. They do not pretend to be accurate, and may be in error both as to the level and as to movement from one year to another; but the broad picture they give may not be too far from the truth.

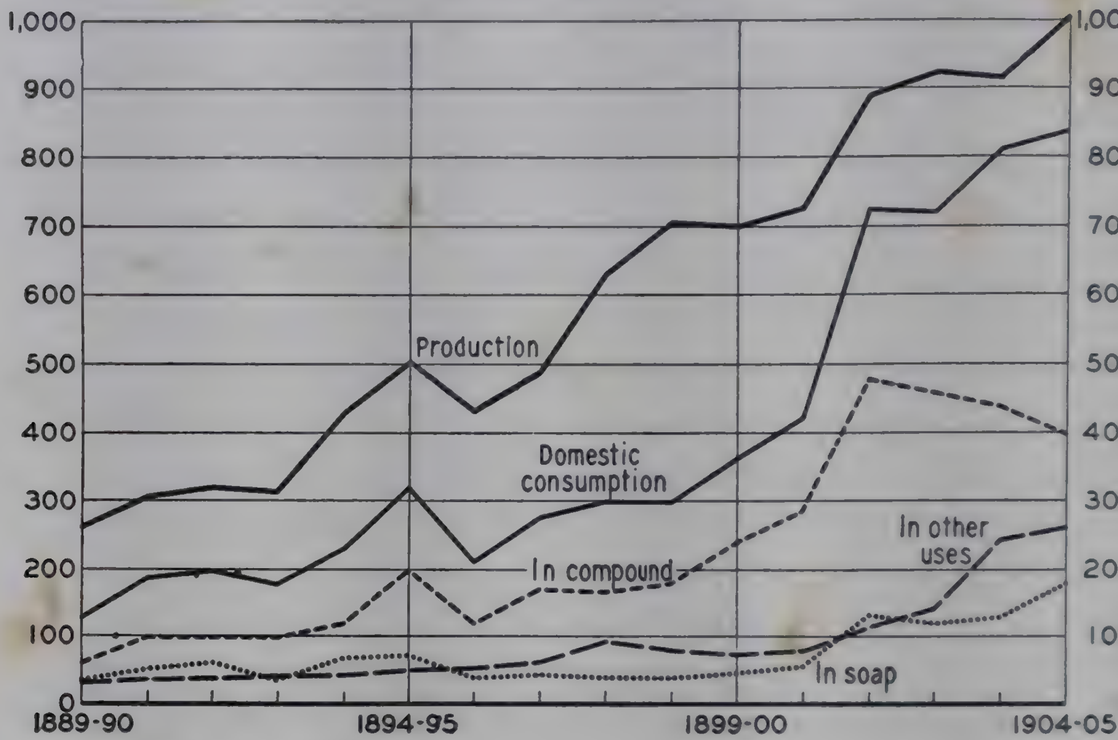
This picture, as given in Chart 3 (p. 64), shows (1) recovery in 1890–91 to a level above that of 1887–89; (2) a sharp expansion from this level in 1893–94 and 1894–95; (3) a severe slump in 1895–96 followed by recovery to a level below the peak of 1894–95; (4) a notable expansion from 1898–99 to 1901–02; (5) a gradual but moderate decline in the next three years. This was followed, as data not here plotted show (Table II), by partial recovery in 1905–06; a sharp decline in 1906–07 and 1907–08, and a recovery in the next three years to the level of 1901–02 to 1905–06. According to this testimony, the greatest expansion of the industry occurred in three years around the turn of the century.

In interpreting this testimony, one important qualification must be made. Cottonseed oil was the principal ingredient of compound proper, and usually the principal

adulterant of lard. But the increasing use of this oil for these purposes does not imply a corresponding increase in the output of adulterated lard or compound proper.

CHART 3.—COTTONSEED OIL PRODUCTION, AND ASPEGREN ESTIMATES OF DOMESTIC USES, 1889–90 TO 1904–05*

(Million pounds)



* Data in Tables I, II.

On the whole, it is probable that the trend in the decade of the 'nineties was toward an increased use of cottonseed oil per unit of the diverse products, though the proportion certainly varied greatly from time to time. Improvements in refining processes (see below, pp. 77 ff.) made it possible to use a somewhat greater percentage of cottonseed oil in the compound formula.

Considering the marked expansion in various lines in the later 'nineties, it is possible that the Aspegren estimates, showing an increase in use of cottonseed oil from around 100 million pounds in 1890–91 to nearly 240 million in 1899–1900, may not overstate the fact; and that the output of compound may have doubled over this period.

Some other estimates deserve passing mention and comment. According to the *Charlotte Observer*,[1] the concerns producing this shortening in Chicago, St. Louis, Kansas City, and Omaha absorbed at least half a million barrels (nearly 200 million pounds) of the crush of the crop year 1892–93. This estimate is double that of Aspegren and Company for the same year,[2] and is probably too high. Subtracting exports of cottonseed oil from the amount produced, the total supply remaining for domestic consumption amounted to 217 and 244 million pounds in 1891–92 and 1892–93 respectively. We are quite certain that other outlets for industrial as well as for food purposes claimed a greater percentage of the total production than would have been available if the *Charlotte Observer's* estimate were correct. It is highly probable, however, that compound production was much greater in 1892–93 than in earlier years, because of relatively high lard prices and a wide margin in price between cottonseed oil and lard. It seems probable that the Aspegren estimate for that year was too low (pp. 66, 69, 70), and that the truth lies nearer to the *Charlotte Observer's* estimate. If the former is revised upward for the early part of the decade, it will indicate a slower rate of growth during the 'nineties than was suggested by the original figures—perhaps more in accord with the non-quantitative evidence which we have on the subject. Both estimates doubtless attempt to account for the total disappearance of cottonseed oil into compound production, regardless of whether the output was sold as refined lard or as compound. The wide divergence between these two estimates, both of which were by those intimately concerned with the cottonseed industry, is indicative of the lack of reliable

[1] Quoted in *Oil, Paint, and Drug Reporter*, October 16, 1893, XLIV, 48.
[2] See Table II.

quantitative information on the operations of this industry during the earlier years of its existence.[1]

Even accurate information on the disappearance of cottonseed oil in compound would not yield exact knowledge of the outturn of the latter in the last decade of the century, for the reason that neither processes nor formulas were as yet standardized, and the ratio between the amount of cottonseed oil absorbed in compound and the volume of output of the industry was probably a shifting one. If we assume, again more or less arbitrarily, that cottonseed oil represented 70 per cent of the materials of compound, the Aspegren estimate would indicate a production of about 350 million pounds of compound by 1900. The output nine years earlier, based on the same ratio and on the same series of estimates, would have been about 140 million pounds. Taking into consideration all known factors, the figure for the earlier year is very probably too small and for the later year somewhat high. The chances are that the latter more nearly corresponds with the facts than the former, if for no other reason than because the industry was better established as an independent entity by the beginning of the new century, and knowledge concerning it was therefore more trustworthy.

As previously mentioned, the only figures on lard production before 1900 are unofficial estimates, presumably of factory output. These estimates, summarized below in million pounds,[2] indicate a pronounced increase in lard

[1] In an article on the cottonseed industry appearing in the *Agriculture Yearbook, 1901*, the statement is made that the packing industry has been reported as taking 30 per cent of the entire cottonseed-oil output for use in lard compound. This estimate is clearly wrong for the years around the end of the century, since average annual exports of cottonseed oil for the four years 1898–1901 amounted to half or more of the entire output. This would leave only 20 per cent for non-packer compounders, for other food outlets, and for all industrial uses, which at that time were still fairly important.

[2] Figures taken from *Oil, Paint, and Drug Reporter*, July 23, 1900, LVIII, 28*c*; original source not stated.

production during the 'nineties from the average of the previous decade, and a rapid rise in the last half of the decade.[1] In 1889–90 the estimate stood at 624 million pounds; by 1898–99 it had risen to 961 million pounds.

Year	Production Nov.–Oct.	Exports July–June	Difference
1889–90	624	471	153
1890–91	775	498	277
1891–92	642	460	182
1892–93	534	366	168
1893–94	539	448	91
1894–95	673	475	198
1895–96	649	510	139
1896–97	806	568	238
1897–98	869	709	160
1898–99	961	711	250

There is a strong presumption that factory output was gaining more rapidly than total output during this period, so that we may perhaps estimate the former to have amounted to about 60 per cent of the latter by the end of the last century. If this is true, total output was in the neighborhood of 1.6 billion pounds in 1899, a figure which tallies closely with the first government estimate for 1900. Lard exports were slightly above 700 million pounds in both 1897–98 and 1898–99 (see Chart 6, p. 99); this would leave some 900 million pounds for domestic consumption. Exports of compound were about 25 million pounds annually at this time. It would thus appear that, by 1900, domestic consumption of lard compound was close to one-third that of lard.

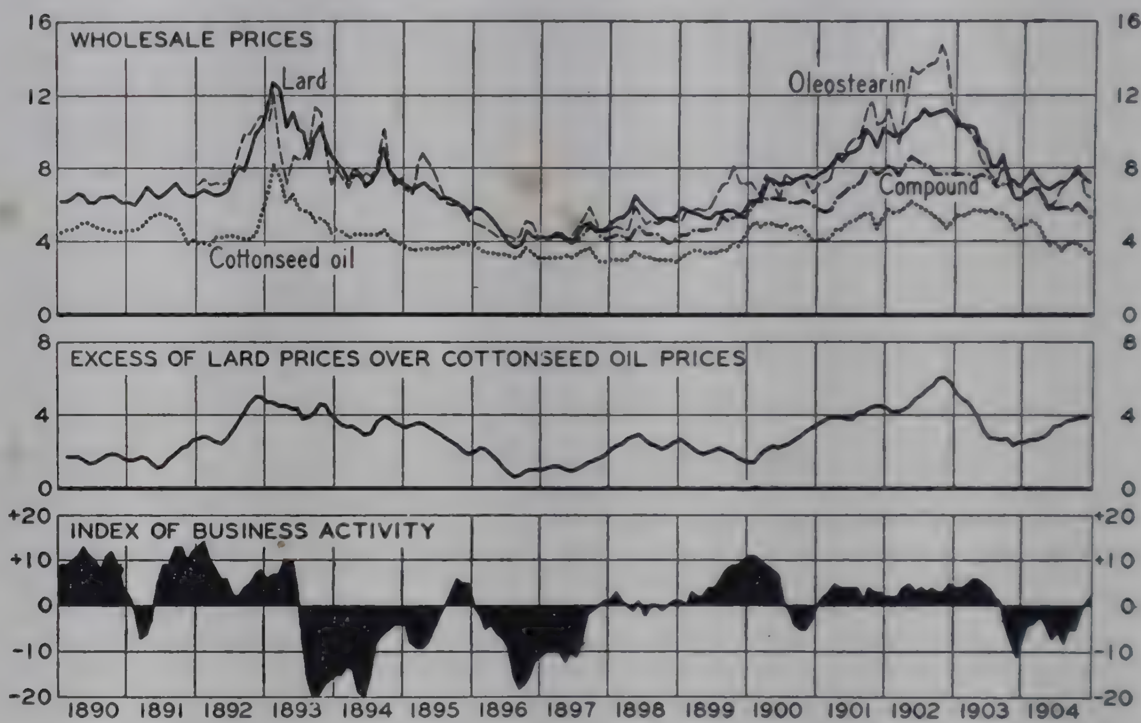
Price Influences in the 'Nineties

The middle years of the decade of the 1890's were unfavorable for the rapid expansion of a new industry. They were marked by widespread business depression (see

[1] *Oil, Paint, and Drug Reporter*, April 14, 1902, LXI, 7.

Chart 4), severe unemployment, and reduced consumer income. They were also marked by the lowest levels of commodity prices for some decades before and after. Particularly important for the compound industry was the condition of the lard and cottonseed-oil markets.

CHART 4.—WHOLESALE PRICES OF LARD AND COTTONSEED OIL 1890–1904, OF OLEOSTEARIN 1892–1904, AND OF COMPOUND 1897–1904; PRICE SPREAD BETWEEN LARD AND COTTONSEED OIL; AND INDEX OF BUSINESS ACTIVITY, MONTHLY, 1890–1904*



* Price data from Tables XXI–XXIV; see also footnote to Chart 2, p. 17.

Throughout the history of the compound industry there has been an intimate relationship between lard prices and the manufacture of compound. As we have seen, an early stimulus to adulteration of lard and the manufacture of lard mixtures was given by the high lard prices of the early 'eighties. When types of compound containing no lard came to be manufactured, these shared in the stimulus given by recurrent periods of rising prices of lard. Conversely, declining prices of lard not only re-

duced the temptation to adulteration but increased the competition of lard with substitutes and made for contraction in compound output. Wide fluctuations of lard prices during the 'nineties therefore inevitably affected the fortunes of the young compound industry.

The relation between lard prices and cottonseed oil prices, shown in Charts 2 (p. 17) and 4, was also important to the industry, since cottonseed oil was the principal adulterant of lard and the principal ingredient of other lard mixtures and of vegetable compound. A wide differential in 1881 and 1882 undoubtedly contributed much to give the industry a good start. On the contrary, as the differential narrowed in subsequent years, this stimulus was removed, and technological and business developments were mainly responsible for the industry's progress. Through most of 1889, when lard prices were declining and low, cottonseed-oil production was light and its price was nearly as high as that of lard. This unfavorable conjuncture doubtless checked expansion in the use of cottonseed oil in lard compound in 1888–89, and caused a sharp setback in its use for compound and soap-making in 1889–90, as shown by the Aspegren estimates (Table II).

From the middle of 1889 lard prices fluctuated for three years within a comparatively narrow range, on a low level averaging around 6½ cents a pound. From late in 1891, however, cottonseed oil sold for four years at a fairly wide differential below lard. This favored a larger use of cottonseed oil in compound, as reflected in the Aspegren estimates.

A marked stimulus was given to compound manufacture in 1892–93. Lard prices rose sharply from around 6½ cents a pound in April and May 1892 to about 12½ cents early in 1893. Though cottonseed-oil prices rose in sympathy, they did not advance nearly as much. The price differential therefore widened greatly. It is not

astonishing that for several years afterward the trade regarded 1892–93 as an exceptionally favorable season. Probably the use of cottonseed oil in compound, and the manufacture of compound in various forms, reached a fresh peak in that year, though the Aspegren estimates strangely fail to reflect it.

Lard prices declined irregularly from their peak early in 1893, but did not fall to the previous low level until the middle of 1895. The price differential, however, remained fairly wide for two years. It is possible that these influences, coupled with larger output of cottonseed oil (Table I), may have led to further expansion in the use of cottonseed oil in compound, as shown by the Aspegren estimates for 1893–94 and 1894–95 (Chart 3, p. 64), though various commentators in trade journals express the view that the peak year was 1892–93. It is probable that the severe depression (see Chart 4, p. 68) and widespread unemployment that prevailed in 1893–94 increased the demand for compound at the expense of lard, which was not so cheap; and it is possible that habits thus established continued to exert a favorable influence on demand when business conditions improved in 1894–95.

In 1895–96, however, lard prices fell to very low levels, and from May 1896 through most of 1897 they remained under 5 cents a pound. In fact, lard became so cheap that some of it was even diverted from food uses to the soap kettle. The differential between lard and cottonseed-oil prices also declined in 1895–96 and remained very small in 1896–97. It is highly probable that 1895–96, which was a year of business recession and reduced supplies of cottonseed oil (Table I), was marked by a severe decline in output of compound, as reflected in the Aspegren estimates. It is rather the picture of considerable recovery in 1896–97 that is open to question. Late in 1897, at the end of a year so discouraging to compounders, a writer

in a current trade periodical summed up the situation in the following sentence:

> Beginning with the season of 1892–93, in which the use of cottonseed oil in compound lard manufacture reached its greatest extent, the declining prices of pure lard have from that year on until the present helped to reduce the quantity of cottonseed oil used in compound lard, and Southern oil presses were compelled to seek other outlets for the oil which they had previously sold to Western compound lard makers.[1]

Similar expressions appear repeatedly in trade journals throughout the period of low lard prices, and make it difficult for the student to credit the industry with any consistent or material expansion during these years.

After the middle of 1897, however, lard prices rose for nearly a year, and remained between 5 and 6 cents through most of 1898 and 1899. Prices of cottonseed oil remained low, and the price differential widened in 1898 but narrowed in 1899. These conditions would seem to have favored expansion and then contraction of the output of compound, but the Aspegren estimates show a stationary level through 1898–99. By the end of 1897 business in general had recovered to normal, and in 1899 a considerable boom occurred. It is possible that with business greatly improved, and lard still very cheap, the demand for compound fell off. Certainly its prices failed to share the improvement in lard prices in 1898.

Not only were lard prices extremely low during the last half of the 'nineties, but the differential between lard and cottonseed-oil prices was smaller than for any period of similar extent since the birth of the cottonseed-oil industry. In fact, in only three years out of the eleven from 1890 to 1900 was the annual average spread as much as three cents per pound, and the average spread for the

[1] *Oil, Paint, and Drug Reporter,* December 6, 1897, LII, 18.

decade was under 2.5 cents. This meant that compounders had little prospect of profitable production, since compound lard could find a market only at a substantial discount below lard prices. Furthermore, there is some evidence that when lard was quite cheap it was taken in preference to compound, even when the latter was considerably cheaper.

Another factor tending to hold in check the growth of this industry was the relatively small proportion of the oil produced in the 'nineties which was suitable for compound lard. The lower grades largely found their way into the soap kettle. Furthermore, as already mentioned, machinery and processes still fell short of realizing the possibilities of cottonseed oil as an edible product.

Trade-Mark and Patent Developments in the Industry

In spite of adverse conditions in the middle 'nineties, producers appear to have had great faith in the future of lard compound. Although we cannot ascertain how much they produced and marketed as compound, we do know that they continued to be active in developing formulas and began to register trade-marks covering various types of manufactured cooking fats. While the large packers as a group were not at first the leading contributors to the development of compounds, they gave evidence of great interest and activity in the field during the 'nineties, particularly through the registration of patents and trade-marks.

Armour and Company was among the early producers of compound. It will be recalled that as far back as 1888 this company was turning out considerable quantities of lard mixed with other ingredients, and at that time, as a result of difficulties in the British market, it announced the policy of henceforth labeling all such products as

mixed rather than simply refined lard, as theretofore. The earliest brand sponsored by this company, so far as government records indicate, was "Vegetole," which was registered at the Patent Office in 1893,[1] with the accompanying statement that production of this brand began in 1890; another source gives the date as 1893.[2]

Swift and Company followed Armour into the compound field in 1893, according to Patent Office records, with a substitute for lard which was registered the same year under the name "Cotosuet."[3] According to an analysis of Cotosuet made by Dr. Wesson in 1894, this compound contained about 24 per cent oleostearin and the balance cottonseed oil. It was light yellow in color, from the addition of some annatto. Cotosuet is still being produced and sold in bulk, largely to kosher bakeries. When it was first put on the market, it was advertised along with the company's Silverleaf brand of pure lard.

Nelson Morris and Company began the production of a "Supreme Shortening" late in 1893, and registered this name soon after.[4]

In February 1895, the Schwarzschild and Sulzberger Company (now merged with Wilson and Company) commenced production of a group of food products under a brand designation which was not registered until 1907. At the time of registration, compound was included in the list of products covered by the brand, but it is not known whether this shortening was put on the market as early as other articles included in the list.

At what time the Cudahy Packing Company entered

[1] Trade-mark No. 23,291, registered July 4, 1893.

[2] Dr. Wesson is of the opinion that Armour and Company began production of lard compound in 1884. This does not necessarily conflict with the government record, since such early output may not have been under any brand name that was later registered, and since it was then doubtless marketed as lard.

[3] Trade-mark No. 22,797, registered April 11, 1893.

[4] Trade-mark No. 24,253, registered February 20, 1894.

the compound field, we cannot state with assurance. In 1907, this company registered a lard substitute under the name "Suetine," and gave the date of beginning production as February 10, 1892. Earlier records of the Patent Office, however, indicate that this product was registered by Robert B. Brown on April 5, 1892. Apparently the Cudahy Packing Company later bought out the plant and trade name from Brown, and re-registered the trademark as its property.[1]

Other packers, as well as lard and cottonseed-oil refiners, continued to make their appearance in the early 'nineties as producers of lard substitutes of one kind or another, and the industry gained representatives in widely scattered parts of the country.

The pioneers of the industry in the South were at Macon, Georgia, and Dallas, Texas. The Armstrong Packing Company of Dallas introduced a shortening composed of cottonseed oil and oleostearin in 1889, under the brand designation of "Bird." In 1896, the same company began production of "Oak Leaf," a compound composed of pure lard, edible fat, and cottonseed oil.[2] Neither brand was registered until many years later.

At Macon, Wallace E. McCaw of the Georgia Mills and Elevator Company developed two successful brands of lard substitutes. In the latter part of 1895 he introduced on the market and registered at the Patent Office a product called "Plantene," which was sold at retail in Georgia

[1] Suetine was first registered under Trade-mark No. 20,944, registered April 5, 1892, and subsequently as Suetene under Trade-mark No. 64,962, registered September 3, 1907. According to Dr. Wesson's personal records, he made an analysis in 1894 of "Rexoline," which he thought was produced by Cudahy at that time. It was light yellow and contained about 79 per cent of cottonseed oil. No record of such a product, however, appears in the files of the Patent Office. A similar product, "Cottoleo," was made by the Central Lard Company of New York. It was yellow and grainy.

[2] The Bird brand was registered September 18, 1917, No. 118,485, and Oak Leaf brand, July 16, 1912, No. 87,404. Since the brand names were uninforming, both may have been sold as refined lard in the early years.

and nearby states for a number of years. Less than a year later, this producer offered "Flakewhite" for distribution to the bulk trade. This brand name is today stamped on the best-selling bulk shortenings produced by the Procter and Gamble Company, which later acquired the McCaw Manufacturing Company.[1]

With each succeeding year, the number of compounds and similar shortenings put on the market grew rapidly, and the list of trade-marks registered during the last years of the nineteenth century and the first two decades of the twentieth is a long one. A large number of brands with Spanish names indicates the importance attached to Cuban, Mexican, and perhaps other Latin-American outlets for lard compounds.

Principal Domestic Outlets for Compound

The principal outlets for compound were probably bakeries, restaurants, and other food establishments, rather than the household trade. It is true that some producers were making brands designed especially for retail distribution, but it is believed that the volume disposed of through these channels was comparatively small. Mr. McCaw, who produced Plantene for the retail trade and Flakewhite for bulk distribution, told one of the writers that twice as much of the latter was sold in the early years.

The most widely sold retail brand on the market was Cottolene, an N. K. Fairbank Company product (see p. 29). Originally, it was marketed in large containers, and sold loose at retail, but due to much imitation it was later put up in small packages. Some difficulty was experienced from complaints regarding its lack of uniform freshness, and later, when improved compounds were put on the market in increasing quantities, its sales were

[1] Plantene was registered November 5, 1895, No. 27,186; Flakewhite was not registered until October 25, 1921, No. 147,672.

maintained only with great difficulty. Its lack of uniformity and stability was probably due to the frequent use of poor-quality oil, largely so-called unbleachable oil. It furnished a relatively high-priced food outlet for such oil, and its yellow color set a fashion. As we have seen, Cotosuet (p. 73) was artificially colored, and other brands followed suit. Some bakers preferred the yellow-colored products in the belief that they were richer. The problem of utilizing unbleachable oil no longer exists; it can be given stability by hydrogenation (p. 92).

Compound was marketed chiefly as a cheap substitute for lard, and the quantity sold varied widely from time to time, changing particularly with the differential between lard and cottonseed-oil prices, and also with the absolute level of lard prices. A variable demand in this sense is not as characteristic of a product which finds its principal outlet among household consumers by displacing a well-intrenched product, as of one destined for commercial and industrial consumers, since it is well recognized that the habits and prejudices of housewives are very slow to yield to price differentials. In fact, it is highly probable that the growth of retail demand for compounds cannot be explained primarily by the fact that over a long period they could be purchased for several cents per pound less than lard. Commercial and industrial consumers, on the other hand, are greatly influenced by price differentials, since the constant pressure for profits urges them to try whatever promises to reduce costs.

Available evidence indicates that production of compound during the 'nineties fluctuated considerably from year to year, and that compounders found it impossible to develop orderly production schedules from one year to the next. During the periods when lard prices were very low, or when cottonseed oil was scarce and costly, compound-

ers stayed out of the market, or rigidly curtailed production. On the other hand, when lard prices rose and promised to remain up for several months, or whenever a substantial spread appeared between the price of lard and that of cottonseed oil, compounders became active consumers of the better grades of oil.

Factors Affecting Expansion Around and After 1900

The turn of the new century and the decade thereafter witnessed a number of developments highly important for the compound industry. Once more we see technical and economic forces contributing jointly to create conditions unusually favorable to its growth.

The Aspegren estimates show a striking increase in the use of cottonseed oil in compound in the three years beginning with 1899–1900 (Chart 3, p. 64). These were years of general prosperity and rising prices of lard and compound, with on the whole a widening differential over prices of cottonseed oil (Chart 4, p. 68). Evidence of a demand for compound more or less independent of lard is afforded by the fact that in 1899 compound prices rose while lard prices did not, and for several months around the end of 1899 the two commodities temporarily sold for much the same price. Expansion in the use of cottonseed oil was promoted by the abundance of this oil. The peak production up to the middle 'nineties was 500 million pounds in 1894–95. In each of the three years ending with 1900–01 production slightly exceeded 700 million pounds, and in the next three years it averaged over 900 million pounds (Chart 3, p. 64).

The deodorizing process developed by Eckstein in 1891 was followed at the end of the decade (1899) by the vacuum process originated by Wesson. This marked such an advance as to "set a new standard for cottonseed oil," and permitted manufacturers to produce an article whose

superiority over earlier products encouraged the rapid expansion of its market.[1] "Snowdrift," introduced in 1900 by the Wesson Process Company (affiliated with the Southern Cotton Oil Company), was the first compound growing out of the Wesson process. Its producers were very fortunate in the time of its appearance. This shortening, though now no longer containing any animal fat, is still marketed under the same name.

The turn of events in the economic world immediately following the development of the vacuum process was highly propitious for the compound industry. During the latter half of the 'nineties, wholesale lard prices had reached a low point to which they have never since fallen. At its lowest in August 1896, prime contract lard in New York averaged 3.7 cents a pound; and in the four years 1896–99 the New York price was rarely as high as 6 cents a pound (see Chart 4, p. 68). During the six years ending with 1900, the price of cottonseed oil averaged about two cents per pound below that of lard. For the following six years, on the other hand, the average annual differential was around four cents per pound. Expressed relatively, lard prices exceeded cottonseed-oil prices by about 56 per cent in the former period and by about 85 per cent in the latter. A great impetus to compound production, so far, at least, as its relationship to lard is concerned, occurred in 1901–02, when crude cottonseed oil available for domestic consumption jumped to nearly 650 million pounds, as compared with around 350 million pounds in each of the four preceding years (Table I). Much of the large supply of refined oil was of good edible quality and could be had at prices ranging from four to six cents per pound below the price which lard was commanding at this time. Naturally, this price relationship

[1] For a description of the technical aspects of these two processes, see Appendix B, pp. 258, 259.

was one highly stimulating to the manufacture of compound, and producers were not slow to take advantage of it. The industry was thus enabled to establish itself on a firm basis from which it was ultimately to take its place among the important food industries of the country.

In spite of marked improvements in the quality of compound, however, habits and prejudices operating against it did not disappear over night. On this point, the *Agriculture Yearbook, 1903,* may be quoted (pp. 412–13) as follows:

> . . . . In domestic life there has always been in the mind of the American housewife a somewhat inexplicable prejudice against the use of vegetable oil for cooking purposes; and until recent years lard had completely usurped the functions here that from remote antiquity had been accorded in many countries to vegetable oils. That this prejudice is being gradually mollified there is no doubt, but it is a tribute to its persistency that vegetable cooking oil even now gains surreptitious access to the American kitchen only under the guise of packages and labels suggestive of lard. . . . .

For some time to come, these products could be marketed in quantity only at a considerable discount below the price of lard.

The three years beginning with 1901–02 were all years of exceedingly large domestic supplies of cottonseed oil, because of heavy production and sharp reductions in exports (Table I and Chart 3, p. 64). Nevertheless, we find compounders obliged to curtail activity in 1904. A marked recession in lard prices in 1903 had brought them down to about seven cents a pound; and since prices of cottonseed oil and compound had declined but little, the margin narrowed materially, though it remained wider than in 1896 and 1897 (Chart 4, p. 68). This bears out an assertion appearing in the *Oil, Paint, and Drug Reporter*[1] that compounders did not find it profitable to operate exten-

[1] July 23, 1900, LVIII, 28.

sively with lard prices under eight cents per pound. Apparently, when many consumers could buy lard cheaply enough they used it in preference to compounds, regardless of the difference in price.[1]

At exactly what margin between the prices of lard and cottonseed oil compounders found it possible to manufacture cooking fat effectively and compete on a large scale with lard, we cannot ascertain with precision. The situation was essentially different for the several classes of manufacturers then participating in the industry. Of these, the meat packers and the cottonseed-oil producers were the two leading groups of competitors.

Position of Cottonseed-Oil Producers in the Cooking-Fat Industry

As we have already seen, the independent lard refiners did not long survive the extensive use of cottonseed oil in the manufacture of cooking fat. As they fell into the hands principally of the cottonseed-oil interests, notably the American Cotton Oil Trust, their good will and manufacturing experience were gained by the concerns which absorbed them. This added substantially to the power of that branch of the compound industry to maintain itself in the face of numerous competitive advantages on the side of the meat packers. The American Cotton Oil Trust (formed in 1884 and in 1889 transformed into the American Cotton Oil Company) and the Southern Cotton Oil Company (formed in 1887) exerted a unifying influence in an industry previously made up of small, scattered and individualistic units. It seems likely that the existence of these two large concerns was an important factor in preventing the achievement of a virtually complete control of compound by the packers. At

[1] Margarine production bears a similar relationship to butter. See Snodgrass, *op. cit.*, chap. xix.

the beginning of the 'nineties, the American Cotton Oil Company accounted for more than half of the total amount of cottonseed crushed. Its control over refining was even greater, although figures are lacking for definite measurement. The Southern Cotton Oil Company was smaller, but was strong and well equipped. Both companies were in a position to withstand considerable competitive pressure.

During the 'nineties and into the new century, however, the relative control by the two large cottonseed-oil companies dwindled rapidly. Independent mills sprang up all over the South, and particularly in the newer cotton-growing areas west of the Mississippi. This once more intensified competition not only in the disposition of the oil but in the purchase of seed.

Among cottonseed-oil producers, the manufacture of compound is primarily a method of marketing the output of their crushing mills and refineries. Whether they can do so at a profit clearly depends on costs of producing the oil and the compound, and on the prices of competing fats. In consequence, competitive bidding for seed among crushers too numerous for the seed available from most crops was a serious obstacle to profitable operations in many seasons when prices for competing fats were not strong. This competition from new mills likewise meant a rapidly increasing output of cottonseed oil and the consequent difficulty of maintaining prices even by so strong an organization as the American Cotton Oil Company.

Cottonseed-oil mills producing compound were further handicapped in their competition with the packers through the fact that their success depended so heavily on their ability to market compound profitably. While this article was not their only product, it was their most important outlet for cottonseed oil after the latter became

too valuable to be used extensively for industrial purposes.[1] Unlike the meat packers, therefore, most of their eggs were in one basket, and they could not usually show satisfactory profits at the end of the year unless the prices realized for compound covered fixed as well as variable charges. Only the large integrated concerns had the advantages of a wider variety of products and a not inconsiderable export market.

The Rôle of the Packers in the Industry up to 1914

It has already been pointed out that the meat packers were in a peculiar sense responsible for the launching of the compound industry although, with few exceptions, they were not originally refiners of lard. Their unintentional achievement of this purpose, as we have seen, came principally through their indifference to the quality of steam lard which they sold to independent lard refiners; this indifference placed squarely on the shoulders of the latter the problem of taking steps to turn out a product not noticeably different from that to which consumers had become accustomed. But the independent lard refiners, in whose plants compound was evolved, and who thereby gave to consumers a new product and to crushers of cottonseed a great outlet for their oil, helped by this very means to bring an end to their own independence. Once compound was fairly launched, its significance to the cottonseed-oil industry became manifest, and the absorption of the leading independent lard refiners, for the most part by the cottonseed-oil interests, soon followed. The refining of pure lard then logically devolved upon the meat packers, who by that time had

[1] The growing market for cottonseed oil as a salad oil absorbed, and even yet absorbs, only a fraction of the volume going into lard substitutes. Some cottonseed oil was also used in frying, especially in the South, in canning sardines, and for other food uses. On this matter, there is no reason for discrediting the broad testimony of the Aspegren estimates given in Table II.

begun to absorb the satellite industries which were engaged in working up and marketing the by-products of meat packing.

But the meat packers were in an excellent position to participate also in the production of compound. We have already noted that Armour and Company, the first large packing house which undertook to refine its own lard, was also one of the principal pioneers in compound production. Financial gossip in the late 'eighties connected Armour with the organization of the Southern Cotton Oil Company, a circumstance which that astute business man turned to his advantage in obtaining from the rival American Cotton Oil Company a very favorable contract for supplying his oil requirements. For refined lard alone, these requirements, according to Mr. Armour himself, amounted to one-fifth of the total cottonseed-oil output of the country.

Other packers rapidly followed the example of Armour. Their activities in the matter of trade-marks and patents have been noted above. It was not long before the meat packers became the most important group of compounders, enjoying a number of competitive advantages which allowed them in considerable measure to dominate the compound industry until close to the outbreak of the World War.

Before pointing out the particular factors which strengthened the meat packers in competition with cottonseed-oil producers of compound, it may be well to consider the circumstances which led the former to engage actively in the manufacture of a product which came into direct competition with lard, now also a packing-house product. Although little direct evidence is available on this point, several such circumstances suggest themselves. In the first place, although most of the meat packers entered the field after the lard controversy

in Congress, and therefore after compound had largely emerged as a new product, the sale of adulterated lard—in a sense, compound lard — as pure lard cannot have ceased abruptly. Therefore, it is reasonable to believe that packers occasionally found it advantageous to "doctor" their refined lard in one manner or another, either when lard supplies were unusually low or when its texture and consistency called for modification, or simply to meet competition. So far as this was the case, they may be said to have drifted into the compounding of cooking fat.

More important, however, was the probably deliberate intention of the meat packers to gain control, so far as might be, of the entire market for cooking fat, compound as well as lard, in order not only to preserve the latter from the full rigors of competition by this new product which it would be expected to meet if compound were wholly in the hands of vegetable-oil producers, but also to participate in whatever profits compound production offered. They doubtless felt that their interests as lard producers would be better served if they were in a position to dominate compound production as well as lard production.

From what meager evidence there is in trade journals of the period, one gathers that the packers were for years a highly important element in making the cottonseed-oil market. They appeared as the major purchasers when lard supplies were relatively scarce and lard prices high. In cases of unexpected declines in lard prices, they even entered the market to sell oil that they had previously purchased for compound production. Pursuit of profits would, of course, dictate such action so long as compound was salable only at a discount below lard, regardless of whether the packers were interested in pushing one product rather than the other. Yet lard, both quantitatively

and in value, was their major interest among all cooking fats, and was the product which they mainly advertised. They seldom risked breaking lard prices by throwing larger quantities of compound on the market than it appeared able to absorb at going price levels.

A measurable degree of control over compound–cooking fat production was important to packers in another way. The packers produced, as by-products, considerable quantities of high-grade edible tallow and oleostearin. Ever since the development of compound, these fats had found their most profitable outlet as a hardening agent for this product. For oleostearin, the United States had never developed an export market of any importance, and the trends toward vegetable oils in Europe, already discernible early in the twentieth century, promised little for the future in that direction. Hence the compounding of cooking fat, composed mainly of cottonseed oil and hardened with oleostearin or edible tallow, offered the packers their best chance of advantageous disposition of these animal fats. To work up this oleostearin into compound was in line with the general packing-house policy of utilizing its own by-products so far as possible. Without doubt, the joint acquisition of cottonseed-oil mills by a group of the leading packers shortly after the turn of the century was inspired mainly by their interest in the manufacture of compound cooking fat.

The fact is clear that the packers sought and obtained a strong position in the compound industry, and that they maintained their strategic position until close to the outbreak of the war. That they were able to gain so much power in the industry during these years was due to a number of factors. In the first place, the leading packing houses were very large organizations with an enormous volume of output of a wide variety of products. They had well-established marketing facilities, with trade connec-

tions and trade names of great importance in distributing their output among both wholesale and retail consumers. On the production side, the diversity of products and their control of lard output gave them a marked advantage in the matter of costs and prices. With the meat packers, compound was of minor importance; and, according to the well-known principle governing joint products, they were in a position, in unfavorable years, to produce and sell cooking fat, either compound or lard or both, at any price which more than covered the direct expenses involved in their manufacture.

The packers likewise possessed a very strong competitive weapon in their control over the supply of oleostearin which, up to 1912 or later, was almost indispensable in the compounding of cooking fat. The supply of oleo oil and oleostearin is limited to about 20 pounds per steer,[1] and the slaughter of cattle during the 'nineties was not keeping pace with the growth of population. Until 1909, or shortly before the development of hydrogenation released compounders from dependence on animal hardening fats, a duty of 20 per cent existed on oleostearin (Table XIX), which tended to restrict its importation. The Meat Inspection Act of 1906 tightened the hold of the great packers on domestic oleostearin production and prices in two ways. It placed additional restrictions regarding inspection upon importation of edible animal products, and made it unlawful for manufacturers doing an interstate business to obtain animal ingredients from any but federally inspected slaughter-houses. This eliminated local packers not participating in interstate trade as a lawful source of oleostearin for any manufacturer whose market was not equally restricted.

The growing concentration of much of the meat-pack-

[1] L. B. Zapoleon, *Inedible Animal Fats in the United States* (Fats and Oils Studies of the Food Research Institute, No. 3), 41.

ing business into a few very great companies facilitated their control over oleostearin prices. Non-packer compounders grew steadily more concerned over their dependence upon their competitors for animal hardening fats. About the middle of 1909, when the price of this fat rose to about 13 cents per pound, the matter was brought up before the annual meeting of the Interstate Cottonseed Crushers' Association. The assertion was there made that compounders had for years felt themselves at the mercy of the packers, who were enabled by the duty on oleostearin to take advantage of their monopoly and to charge the compounders a price up to that at which the commodity could be imported over the duty.[1] In December of that year, the price of oleostearin soared to 19 cents on the New York market, and many of the smaller independent producers of compound became pessimistic over the future of the industry. Chemists in the employ of cottonseed-oil producers intensified their search for suitable substitutes for oleostearin and tallow. As we shall see, they soon found that such a substitute was to be had within the resources of their own laboratories.

Packers not only controlled the supplies of animal fats required for the manufacture of compound, but they likewise acquired mills to assure themselves adequate supplies of cottonseed oil. There is definite evidence of packer ownership of crushing mills as early as 1902, and by 1905 refineries were added to their holdings.[2] It is quite possible, and perhaps probable, that packers were financially interested in cottonseed-oil mills before 1902. Even during the 'nineties, they were undoubtedly among the largest domestic consumers of cottonseed oil, not only for compound but for other products as well. They used cottonseed oil in margarine, soap, and perhaps some

[1] See *Oil, Paint, and Drug Reporter*, May 24, 1909, LXXV, 28 ff.

[2] Federal Trade Commission, *op. cit.*, 218.

other articles; but these, as compared with compound, were of minor importance in respect of the bulk of cottonseed oil used. They also used the by-product of cottonseed crushing—cottonseed meal—in stock feed and fertilizers. With them, the acquisition of mills was a step toward control of raw materials needed in the manufacture of packing-house products and by-products.

The ownership of cottonseed-oil mills by the leading packers expanded rapidly after 1905. In 1907, Armour, Swift, and Morris jointly and secretly acquired seven additional mills in Texas and Arkansas. They likewise combined in the purchase of a refinery in the same year, to supplement the Memphis refinery purchased by Swift in 1905. From then on, further acquisitions were made until, by 1917, 28 crude-oil mills and 15 refineries were under packer ownership.[1]

This increased ownership of cottonseed-oil mills was not accompanied by a parallel increase in packer output of compound. As a matter of fact, some years before 1917 the packers had lost an important source of power in the industry through the development of commercially successful methods of hardening oil by hydrogenation, which rendered compounders independent of oleostearin. The packers may have had their eyes on ultimate absorption of the compound industry during the first years of their program of cottonseed-oil–mill purchases, but it is certain that they continued to acquire mills after they had lost their dominant place in the industry.

Volume of Output under Federal Inspection

The new meat-inspection law of June 30, 1906,[2] made mandatory the "post-mortem examination and inspection of the carcasses and parts thereof of all cattle, sheep,

[1] Federal Trade Commission, *op. cit.*, 258.

[2] See 34 Stat., 674.

swine, and goats to be prepared for human consumption . . . . for transportation or sale as articles of interstate or foreign commerce." The Department of Justice held that lard substitute and the establishments in which it was manufactured were subject to inspection under this law, even when no slaughtering or meat packing was done therein and even though the animal fat used in the manufacture of the lard substitute was derived from an establishment inspected under the law.[1] The regulations made for the administration of the law provided how lard substitutes are to be labeled. When not over 20 per cent of oleostearin, beef fat, or mutton fat is added to lard, the label of the product was required to bear the statement "oleostearin added," "beef fat added," or "mutton fat added," respectively, as the case may be.[2] Mixtures, of which the lard ingredient equals or exceeds in amount the other ingredients combined, may be labeled "lard compound," provided all the ingredients in the mixture are stated on the label in a prominent manner in the order of their percentages and preceded by the statement "composed of," or "made from," or an equivalent statement.[3] It is to be noted that this regulation contains the first specific definition of lard compound and limits this term to products containing over 50 per cent of lard. The regulations further provided that products containing vegetable oil must give upon the label the names of all ingredients.[4] This regulation was subsequently (1919)

[1] "Opinion by J. A. Fowler, Acting Attorney-General, United States Department of Justice, upon the question whether lard substitute and the establishments where the same is manufactured are subject to inspection under the Meat-Inspection Law (34 Stat., 674)," U.S. Department of Agriculture, *Office of the Solicitor, Circular 38,* 1910.

[2] Regulation 17, Section 9, Paragraph 6, of "Regulations Governing the Meat Inspection of the United States Department of Agriculture," *U.S. Bureau of Animal Industry Order 211,* July 30, 1914.

[3] *Ibid.,* Paragraph 7.

[4] *Ibid.,* Paragraph 8.

modified so that the term "vegetable fat" may be used instead of enumerating each vegetable ingredient.[1]

One consequence of the Meat Inspection Act was, then, the disclosure on labels of all the ingredients (though not their exact proportions) in compounds shipped in interstate or foreign commerce. The Food and Drugs Act, enacted at the same time, does not require manufacturers to make such disclosures; it merely provides that the statements a manufacturer elects to place upon the label must not be false or misleading in any particular. Therefore, compounds consisting of purely vegetable ingredients are usually labeled in such a way as not to disclose the composition, and the general public, for the most part, is quite ignorant of the nature of the raw materials from which they are made other than that these are of vegetable origin.

Another consequence of the passage of the Meat Inspection Act was that annual data on the volume of production of compound by plants doing interstate business and, therefore, subject to federal inspection became available (Table X). Unfortunately, there are no corresponding figures covering establishments not subject to the law, and there is no way of knowing definitely what percentage of the total output in the early years is represented by these figures. Presumably they included the bulk of the output so long as oleostearin was generally used. The first estimates from official sources purporting to include the entire industry are those prepared by the United States Bureau of Chemistry in collaboration with the United States Food Administration, and cover the calendar years 1912, 1914, 1916, 1917, and 1918 (Table X). According to these figures, compound production by federally inspected plants amounted to nearly three-fourths

[1] *Amendment 12 to U.S. Bureau of Animal Industry Order 211*, October 23, 1919.

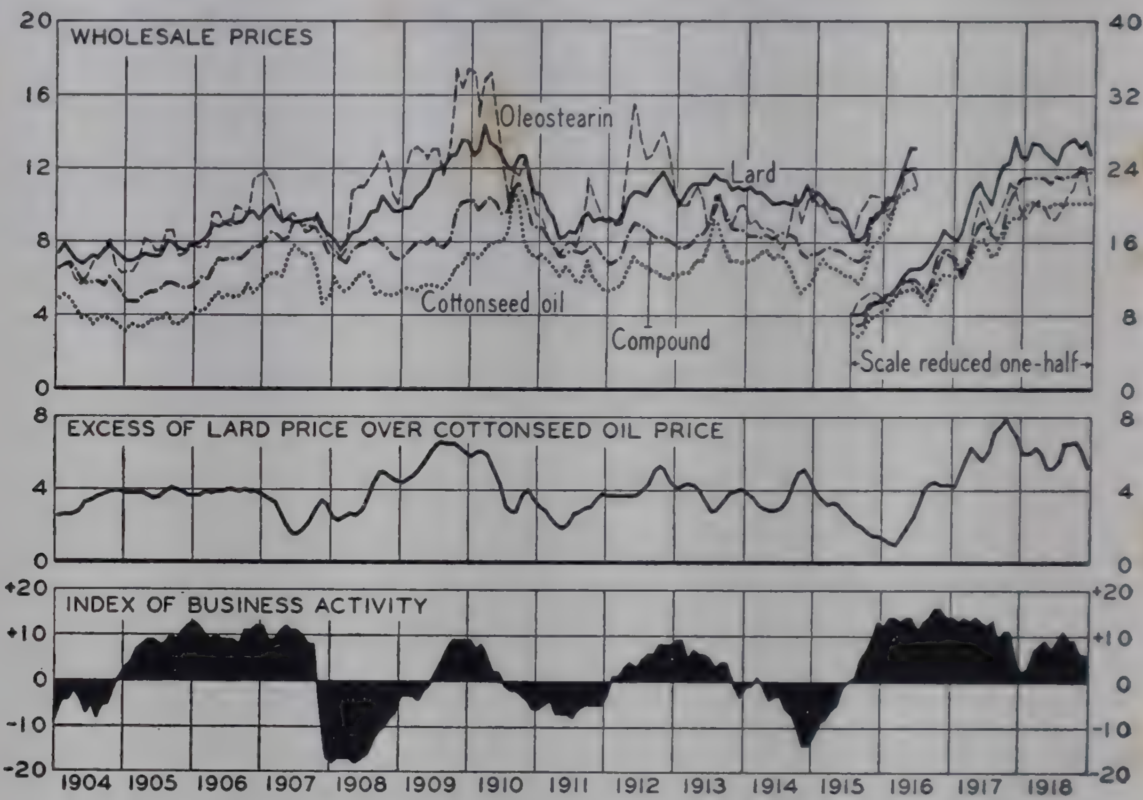
the estimated total output in 1912. For the other years covered in this estimate, inspected establishments on the average accounted for about 43 per cent of the aggregate production.[1] It is not until 1922 that we have regular annual (and quarterly) figures of the volume of compound production covering virtually all establishments. The figures of the United States Bureau of Animal Industry on the production of compound in plants subject to its supervision show an increase of over 50 per cent between 1907–08 and 1909–10, when output reached about 672 million pounds; and the federally inspected output remained at about this level for four years. The three years following 1912–13, however, showed a steady decline in production of compound in such establishments, and from this decline full recovery has never been made (Chart 9, p. 107).

It is not difficult to account for the expansion of 1907–10. The year 1907–08 was one of short supplies of cottonseed oil (Table I), narrow spreads between lard and cottonseed-oil prices, and sharp business recession (Chart 5, p. 92). For some months prices of compound were almost as high as lard prices. Early in 1908, however, lard prices began an advance that lasted until early in 1910. With increasingly abundant supplies of cottonseed oil (Table I), its price remained low until the middle of 1909, and the spread between lard and cottonseed-oil prices continued wide until the middle of 1910, when lard prices were receding while oil prices were advancing. During 1909, the spread between lard and cottonseed-oil prices averaged 5.8 cents; this differential was greater than for any year as far back as 1876, and was not exceeded until 1917 (Table XXV). The spread remained fairly wide

[1] It is not strictly accurate to compare year-to-year figures of inspected-plant production with the estimates prepared by the U.S. Bureau of Chemistry, since the former are on a fiscal-year basis and the latter are for calendar years.

through most of the next few pre-war years, as supplies of cottonseed oil became still more abundant (Table I); and there seems no reason to doubt that total compound

CHART 5.—WHOLESALE PRICES OF LARD, COTTONSEED OIL, OLEOSTEARIN, AND COMPOUND; PRICE SPREAD BETWEEN LARD AND COTTONSEED OIL; AND INDEX OF BUSINESS ACTIVITY, MONTHLY, 1904–18*



* See footnotes to Charts 2 and 4, pp. 17, 68.

production continued to expand even though the output reported in federally inspected plants failed to increase after 1909–10 and declined after 1912–13.

ECONOMIC EFFECTS OF HYDROGENATION

For other factors in the decline of lard-compound production in inspected plants after 1912–13, we must turn from market conditions to events that were transpiring in the chemist's laboratory. The successful development of hydrogenation as a method of hardening fats was being accomplished, and its steadily increasing

use in the production of compound was eliminating the need for oleostearin, and with it the volume of compound production subject to federal inspection.[1] A discussion of the technical aspects of hydrogenation and the story of its development are given in Appendix B.

The first concern to make use of this method in the production of compound was probably the Procter and Gamble Company, which, up to the time of its acquisition of the American rights to the Normann (Crosfield) patent, was a soap-manufacturing enterprise with no output of edible products. This concern had previously acquired a number of cottonseed-oil mills in order to control its needed supplies of this oil for soap making. With the growth of food outlets for cottonseed oil, however, this product became too valuable for use in soap, and the company was forced to decide whether to dispose of its cottonseed-oil–mill holdings or to find a food outlet for the product of its mills. Having determined on the latter course, the Procter and Gamble Company approached Mr. McCaw of Macon, Georgia, who was the producer of two successful compound brands, Plantene and Flakewhite. Mr. McCaw sold out to this company at the end of 1908. Several months later, as agent for the company, he visited England to negotiate for the purchase of the Crosfield patent rights for hydrogenating oil. After securing the American rights to the patent, he returned home to devote himself to furthering the practical de-

[1] However, in the early days of hydrogenation, some firms for a time continued to use a small amount of animal fat in order to remain under inspection by the U.S. Bureau of Animal Industry and thus to be able to continue the legend "U.S. Inspected and Passed" on their labels. Aside from freeing compounders from their dependence upon meat packers for stearin, hydrogenation had another important effect. It improves off-grade oils and makes them more stable so that they can be used more freely in compound without risk of rapid deterioration. Hydrogenation made a much larger proportion of the cottonseed-oil production available for use in compound and has, therefore, been an important factor in determining that in recent years so small a fraction of the cottonseed-oil crush has been used for other than food purposes.

velopment of the production of hydrogenated oils for compound by the Procter and Gamble Company.

The first step in the new venture was the experimental production and marketing at wholesale of a shortening containing hydrogenated oil and a very small amount of oleostearin. The nature of the product was kept secret until disclosure was compelled by official action under the Food and Drug Act and the Meat Inspection Act. The use of oleostearin was soon completely abandoned.

In 1911 the company put out a retail package under the name "Crisco," which is an abbreviation of the words "crystallized cotton oil." The Procter and Gamble Company had the wisdom to present it to the public as a new, purely vegetable product. The absence of any animal fat was featured in advertising, so that it appealed to that portion of the public which for esthetic or religious reasons objects to cooking fats of animal origin. Undoubtedly, its great commercial success is due in no small measure to this wise plan of marketing, and to intensive and persistent advertising throughout the country.

Other concerns also began hardening oils by hydrogenation, including the N. K. Fairbank branch of the American Cotton Oil Company, the Southern Cotton Oil Company, and the packers. There followed a long period of litigation, initiated by the Procter and Gamble Company for alleged infringement of patents. In the end, the patents were held to be invalid, and the way was opened for the general use of hydrogenation in producing compound. By the time our country entered the World War, the use of this method had attained considerable commercial importance.

Growing Independence of Compound

Throughout the 'nineties and the earlier years of the new century, when compound was quite subordinate to

lard in volume used, and when it had scarcely any independent clientele of consumers, the dominant influence of lard on the general market for cooking fat and on the compound industry was unmistakable. Manufacturers could not operate without the closest attention to factors determining the trend of lard prices, and in consequence, to cottonseed-oil producers likewise, the lard market was a matter of prime importance. It continues to be important up to the present, in spite of some shifts in relationships. As early as 1907, however, there was beginning to manifest itself an ability on the part of cottonseed oil and its edible products materially to influence the trend in prices among edible fats and oils. In the spring of that year, when cottonseed oil of edible grade was unusually scarce, its prices were maintained at levels which demonstrated a discernible degree of independence of fluctuations in lard prices. This was a matter new enough to call for special comment in the market pages of the *Oil, Paint, and Drug Reporter.*[1] For a time, in fact, cottonseed-oil prices continued to rise in the face of declining prices of lard, greases, and tallow; and at one time the New York quotation for compound was slightly in excess of that of lard. The special circumstances to account for this probably lie in the relatively short supply of edible cottonseed oil and the unusually large outturn of lard in 1907 and 1908 (Table IX). There is foundation for believing that, for these reasons rather more than the severe industrial recession of 1907–08, production of compound was restricted in these years. Since this product still served as a cheaper substitute for lard, hard times might be expected to increase rather than diminish the demand for it in some quarters.

[1] "The prevailing scarcity [of cottonseed oil] has practically made the market independent of any competing commodity, and the fluctuations of lard, tallow, etc., have had no appreciable effect on quotations of cottonseed oil" (June 3, 1907, LXXI, 19).

The wide spread between lard and cottonseed-oil prices in 1909 and 1910 has already been mentioned. This spread gave further impetus to compound production. Abnormally low lard production for two years pushed its price to an average of 11.7 cents per pound during the calendar year 1909 and 12.5 cents in 1910 (Table XXI). The demand for compound was so great that compounders had difficulty in obtaining adequate raw materials, especially oleostearin. Although unusually large supplies of cottonseed oil were available at this time, the demand was sufficient to raise the price of this oil to an average of 8.1 cents per pound in 1910, a level never before reached (Table XXII).

It may be presumed that these recurrent periods of great stimulus to the compound industry had more than a temporary effect. Many consumers who had previously harbored a prejudice against vegetable shortening were led to purchase it because of its relative cheapness. In so doing, some of them undoubtedly found it as satisfactory for their purposes as lard, and thereafter needed little or no price concession to induce them to buy. Thus, little by little, did the compound industry intrench itself in the field of domestic cooking fats, in which only a few decades earlier lard had held undisputed sway.

Export Trade in Compound Cooking Fat

For years before compound became an important product, the meat packers and the two large cottonseed-oil companies had successfully undertaken to develop foreign outlets for their products. As compound production developed, they naturally included this article in their foreign sales activities. These efforts met with some measure of success.

Until 1892–93, no separate figures for exports of compound were compiled, and such exports as were made

were probably included under lard. In the next four years, separate figures, summarized below,[1] were shown for Cottolene (first made by the N. K. Fairbank Company in 1887) and Lardine (introduced as Lardene by Samuel Read in 1892).

	1892–93	1893–94	1894–95	1895–96
Quantity (thousand pounds)				
Cottolene	570	524	444	1,274
Lardine	342	498	60	436
Total	912	1,022	504	1,710
Value (thousand dollars)				
Cottolene	44.8	39.7	34.3	78.3
Lardine	28.0	38.3	3.8	24.0
Total	72.8	78.0	38.1	102.3
Average price (cents per lb.)				
Cottolene	7.9	7.6	7.7	6.1
Lardine	8.2	7.7	6.4	5.5
Total	8.0	7.6	7.6	6.0

In 1896–97 the classification was extended to read "lard compound, and substitutes for (Cottolene, Lardine, etc.)," and the total reported was 16,262 thousand pounds (Table V). Much of the striking increase was due, no doubt, to the enlargement of the classification. There probably was, however, a real increase in exports of compound in 1896–97, for prices of lard and compound were very low and business was exceptionally depressed in the United States, while revival or even prosperity was manifest in

[1] Basic data from *Commerce and Navigation of the United States*. The 1892–93 quantity total shown was given in later volumes. The 1895–96 quantity total is erroneously given as 500,000 less in later volumes.

most of Europe.[1] Exports of lard also increased substantially in the same year.

Exports of compound rose continuously in the next decade, to a peak of 80 million pounds in 1906–07; thereafter they declined to 58 million in 1913–14. As shown by Chart 6 (in which the scale for compound exports is ten times that for lard exports), compound exports continued small in comparison with lard exports from the United States,[2] which seldom fell below 400 million pounds a year and occasionally rose over 700 million. Of the combined exports of lard and compound, the latter seldom constituted as much as 10 per cent, and only in 1909–10, when lard exports fell to the exceptionally low figure of 363 million pounds, did compound exports constitute as much as one-sixth of the combined export.

Exports of compound also constituted a much smaller fraction of the domestic factory output. Lard exports usually exceeded the factory lard retained for domestic use and, on the average, absorbed probably a third of the entire output in the pre-war decade; whereas even at their peak in 1906–07 compound exports probably did not absorb more than 15 per cent of the output, and in the pre-war decade probably averaged less than 10 per cent.

In the early years, the great bulk of the compound exports went to western Europe (Tables VI–VI *B*, and Chart 7, p. 100). Official statistics by export destinations cannot be wholly relied upon to indicate the countries of ultimate consumption, but it is probably safe to accept their testimony that in the early years Great Britain and Germany were the heaviest purchasers, though the export statistics probably overstate British and understate Ger-

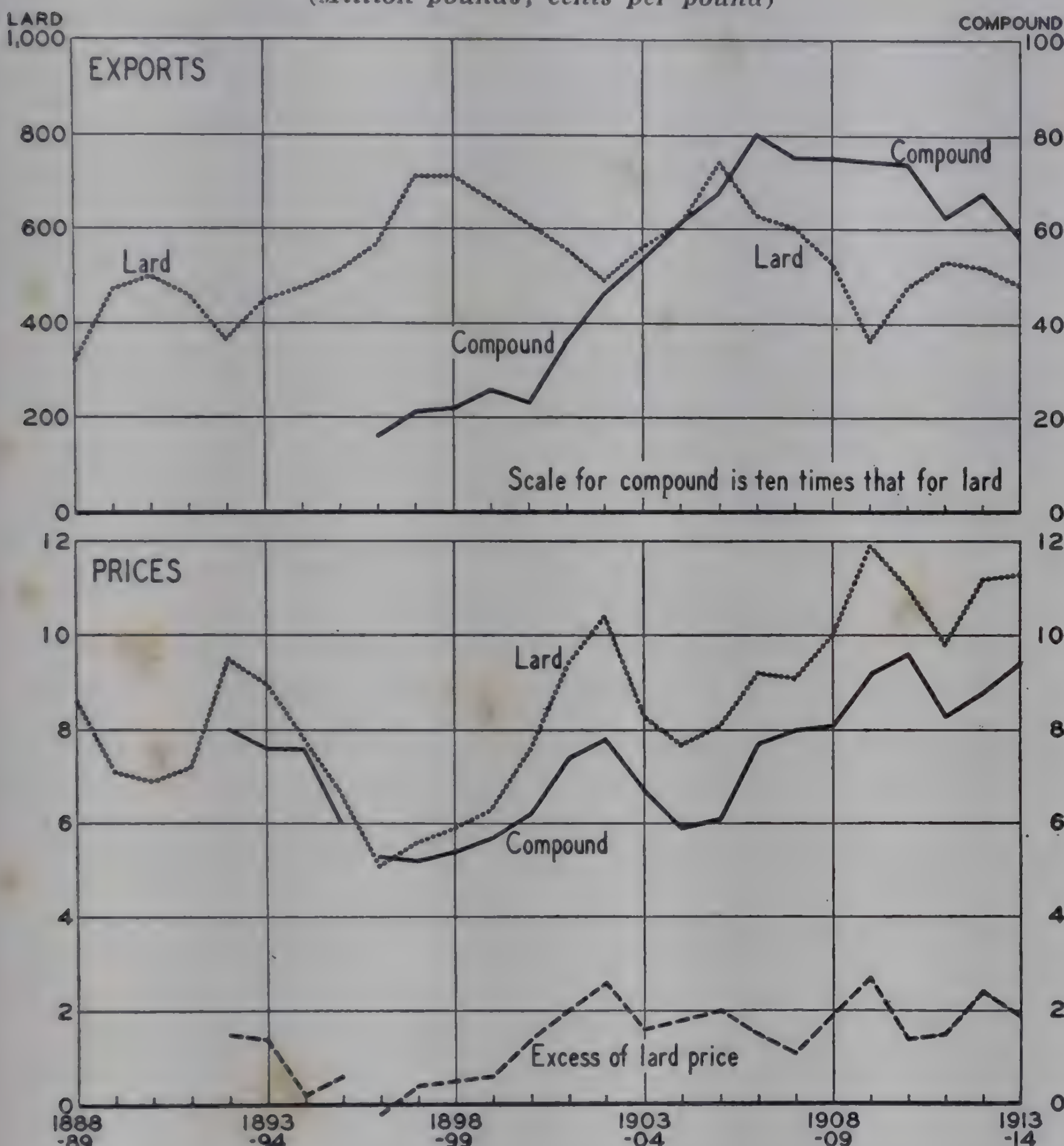
[1] *Business Annals*, 80.

[2] The proportion was substantial only in two regions. After early in the century compound exports tended for some years to vary inversely with lard exports to Cuba and the West Indies; while to Mexico and Central America exports of the two products tended to vary together.

man consumption of imported American compound. Exports to Great Britain increased to a peak of 26.4 million pounds in 1909–10, and she remained an important

CHART 6.—EXPORTS AND EXPORT PRICES OF LARD AND COMPOUND, 1888–89 TO 1913–14*

(Million pounds; cents per pound)



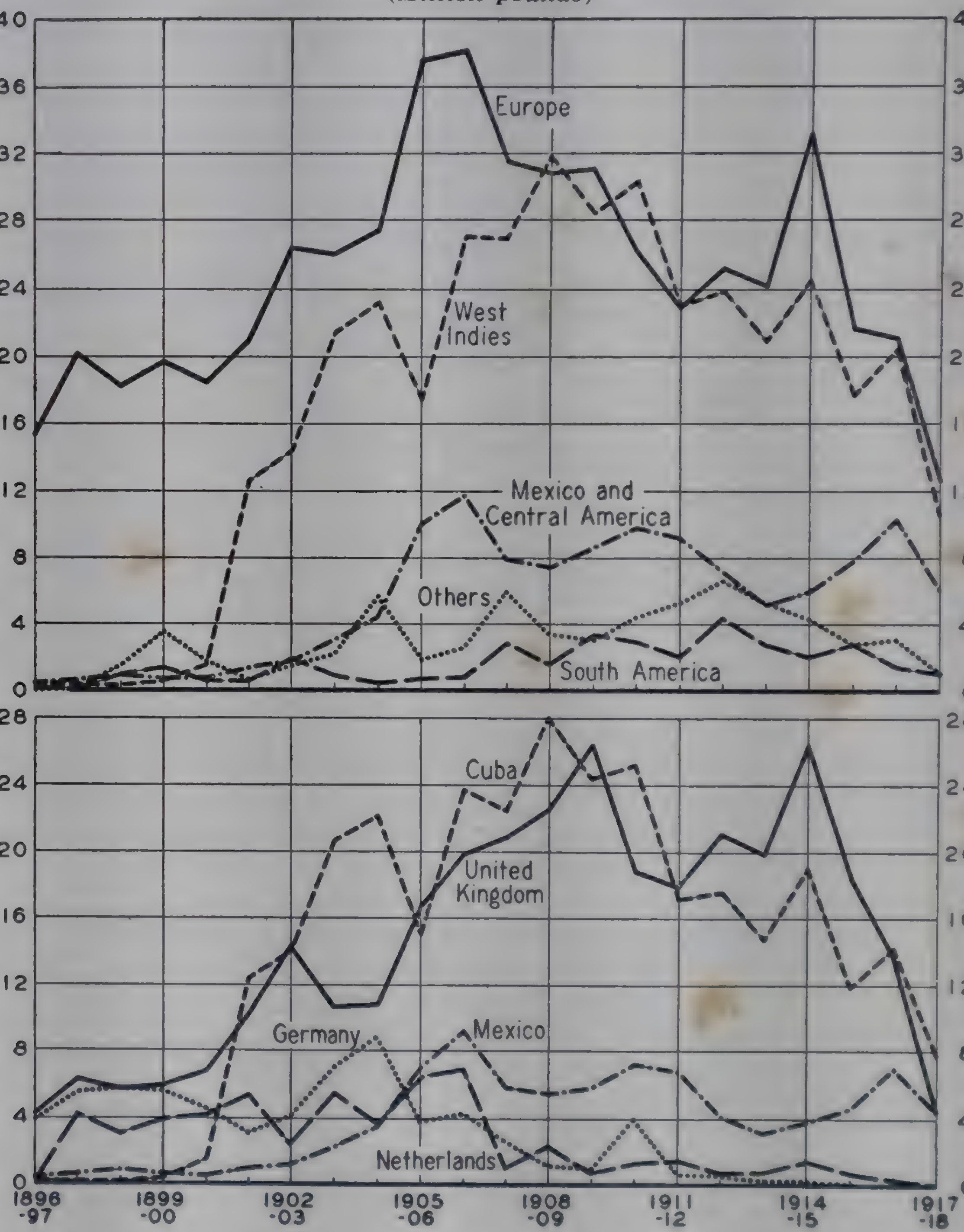
* Data in Table V.

customer until 1916–17. Exports to Germany, on the other hand, exceeded 7 million pounds only in 1903–04 and 1904–05, and had fallen to small proportions before war

broke out. The Netherlands figures heavily in the statistics, but may have sent on to Germany and other countries a good part of the exports shipped to her. France

CHART 7.—COMPOUND EXPORTS TO PRINCIPAL DESTINATIONS, 1896–97 TO 1917–18*

(*Million pounds*)



* Data in Tables VI–VI *B*.

occasionally (as in 1896–97) took large amounts, but was an erratic importer.

After Cuba was freed from Spain and given preferential trade relations with the United States, her takings of compound increased rapidly, by 1901–02 exceeding those to Great Britain. In the five years ending with 1910–11 exports to Cuba averaged 24.7 million pounds and constituted about a third of the total exports. The subsequent decline, from 25.2 million pounds in 1910–11 to 14.7 million in 1913–14, accounted for much of the prewar decline in total exports of compound.

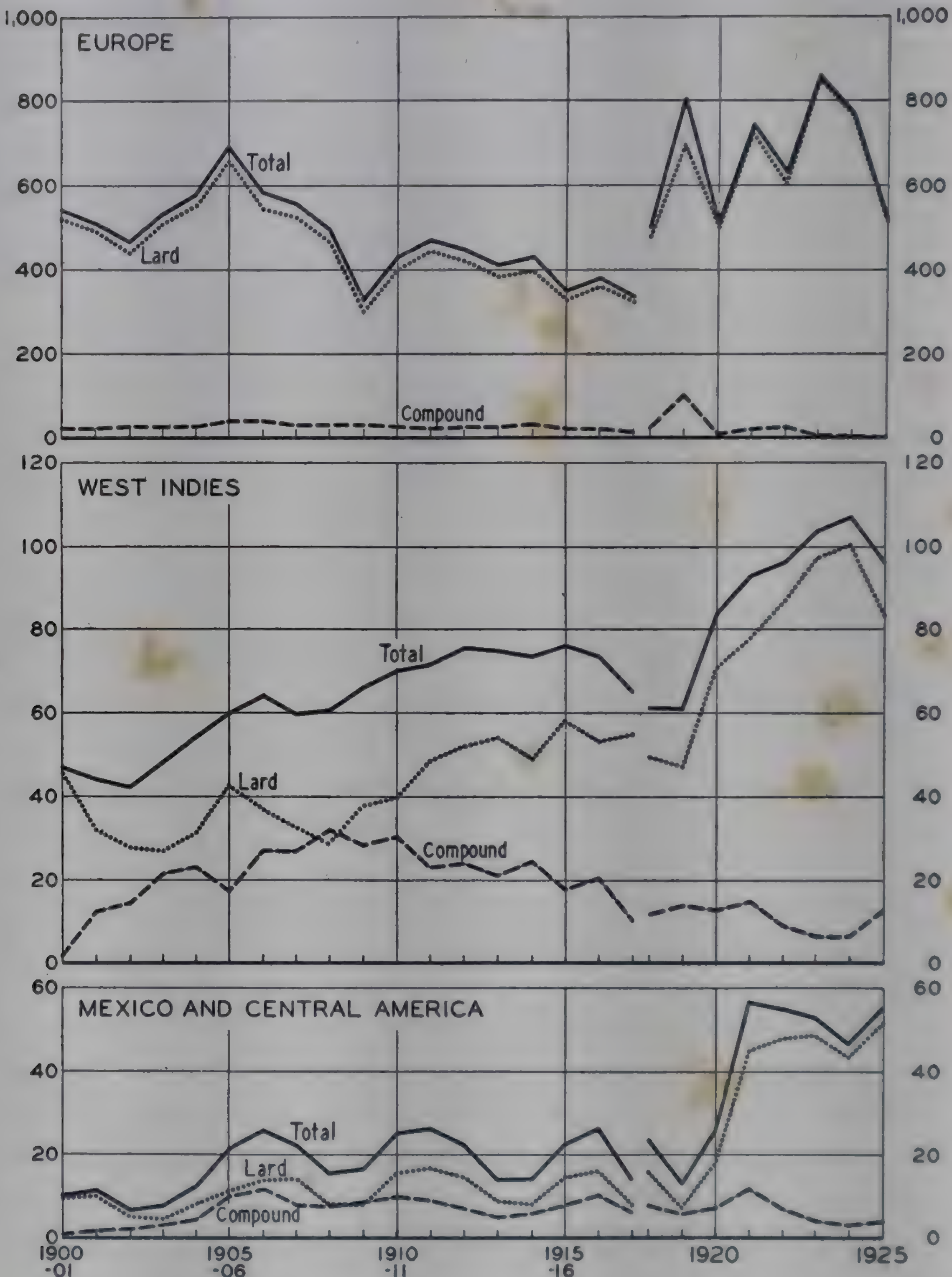
Exports to Mexico also rose rapidly in the early years of the century, and from 1905–06 until 1916–17 exports to Mexico were larger than to any other country except Great Britain and Cuba. Less important markets which took appreciable quantities in this period were Panama, Haiti, and the British West Indies.

In the aggregate Mexico, Central America, and the West Indies took more than European countries from 1906–07 until 1918 except only in 1914–15. With occasional exceptions, other outlets were of minor consequence before and during the war, even in aggregate amounts. At their peak in the five years beginning with 1909–10, exports to South America averaged 3.2 million pounds a year, and exports to the Philippines averaged 2.6 million pounds a year in the five years beginning with 1911–12.

The destinations of our compound exports correspond more nearly with those of lard than with those of cottonseed oil. But only to the West Indies (chiefly Cuba) and Mexico and Central America did exports of compound approach and occasionally exceed those of lard (Chart 8, p. 102). Great Britain has been the main market for lard exports from this country, and Germany usually a close second. In both countries, and in all Europe, takings of

CHART 8.—EXPORTS OF LARD AND COMPOUND TO EUROPE, TO WEST INDIES, AND TO MEXICO AND CENTRAL AMERICA, 1900–01 TO 1925*

(*Million pounds*)



* Data in Tables VI–VI *B*.

compound were small in comparison with their imports of American lard. Germany began to lose interest in American compound about 1906. This reduction in exports to Germany may be due in part to German tariff regulations, and perhaps to some extent to the establishment of plants there by both American and German producers.[1] The largest factors, however, were probably the growing margarine industry and the policy of encouraging the importation of oilseeds rather than of the oils expressed from them.

In the absence of any tax on margarine, that product has come to be used more and more in Europe, not merely as a spread for bread, but also as a cooking fat—especially as a shortening. The great growth of the European margarine industry in the face of the growing shortage of animal fats was made possible by hydrogenation and by the availability of cheap solid vegetable fats, namely, coconut, palm, and palm kernel oils, which are solid in the cool temperate zones. Indeed, ways and means have been found to give these oils through mechanical treatment a certain degree of plasticity, so that in Germany some of them are used to an appreciable extent as cooking fats unmixed. In many European countries, it has been the policy to favor the importation of oilseeds rather than of oil, by admitting the seeds free while imposing a tariff upon the oil. The purpose is not merely to build up a domestic oil-crushing industry, but also to make available the oil cake as a stock feed. Most north European countries are vigorously encouraging ani-

[1] The Aspegren estimates of the uses to which our exported cottonseed oil was put (Table III) include, in 1905, some 400,000 pounds for lard compound. Germany may have been going into the production of compound about this time or soon after. During the five years preceding the World War, the United States on the average exported nearly 100 million pounds of cottonseed oil to Germany. A large part of this oil of edible grade was probably used in the manufacture of margarine, but considerable quantities may also have found their way into other cooking fats.

mal husbandry, and their policy with regard to oilseeds is an important element in this program. The net result is to discourage the importation of cottonseed oil from the United States, whether as such or in some one of its manufactured forms. This policy has, no doubt, had its repercussions in the United States in favoring the retention for use in cooking fat of cottonseed oil that might otherwise be exported, and in favoring the export of a corresponding volume of lard.[1]

Summary

The quarter of a century preceding the outbreak of the World War in Europe brought to maturity the compound industry which had its beginnings in the lard-adulteration practices of the 1870's and 1880's. Particularly eventful were the years of the new century both in technological advances and in improved economic position of the industry. Those years yield unmistakable evidence of the ability of a cooking fat, largely vegetable, to make a place for itself of considerable importance in the market long almost completely dominated by lard.

Because official statistics of both lard and compound production are virtually non-existent before 1900, and because after that year up to 1922 the figures for the latter are fragmentary, while lard-production data are inexact, the task of determining the competitive relationship of lard and compound before the outbreak of the war is a difficult one.

Certain facts, however, are reasonably clear. In the first place, there was no noticeable tendency during that period for the newer compound to displace lard on the domestic market through reducing per capita consumption of the latter. This figure, according to the United

[1] A. E. Taylor, *Corn and Hog Surplus of the Corn Belt* (Miscellaneous Publications of the Food Research Institute, No. 6), February 1932, p. 554.

States Bureau of Animal Industry, fluctuated slightly around an average of close to twelve pounds throughout the fifteen years beginning with 1900. If these figures are reasonably trustworthy, to the extent that compound was consumed in increasing quantities during these years, it found a market as an addition to, not a substitute for, the consumption of lard at the earlier levels.

It is further to be observed that the ratio of compound prices to lard prices underwent no permanent change during these fifteen years ending with 1914. Omitting 1900, which is out of line with other years, we find the average ratio for the three years 1901–03 to be almost identical with the average ratio for 1912–14.

There is no doubt that compound production was increasing, albeit irregularly, throughout those years. Cottonseed oil retained for domestic consumption mounted with considerable rapidity, and its principal outlet was undoubtedly compound. The production of this cooking fat in establishments under federal inspection increased greatly between 1907, when the Meat Inspection Act had become effective, and 1912, when the effects of the hydrogenation process were beginning to manifest themselves. In 1912, the first year for which an estimate of the total output of compound is available, it would appear that the newer cooking fat had achieved a volume of production more than half as great as that of lard.

In the year which witnessed the outbreak of the World War estimates of total compound production were 520 to 580 million pounds less than estimates of total lard production, but exceeded federally inspected lard production by 100 to 170 million pounds.

CHAPTER IV

WAR-TIME AND POST-WAR DEVELOPMENTS, 1914–32

By 1914 the manufacture of compound had reached industrial maturity. In volume of output a level had been attained which has not since been greatly exceeded except in 1919. Though animal fats and oils continued to be used as ingredients in a considerable fraction of the output, vegetable oils constituted by far the greater part of the materials used, with cottonseed oil heavily predominating. Exports, though never more than a small fraction of production, had risen before the war to levels not since exceeded except in the single year 1919. The war and post-war periods, which can be studied with the aid of somewhat better statistics, have many features of interest; but the developments were neither as striking nor as significant as those which took place in the more obscure period before the World War.

Volume of Output

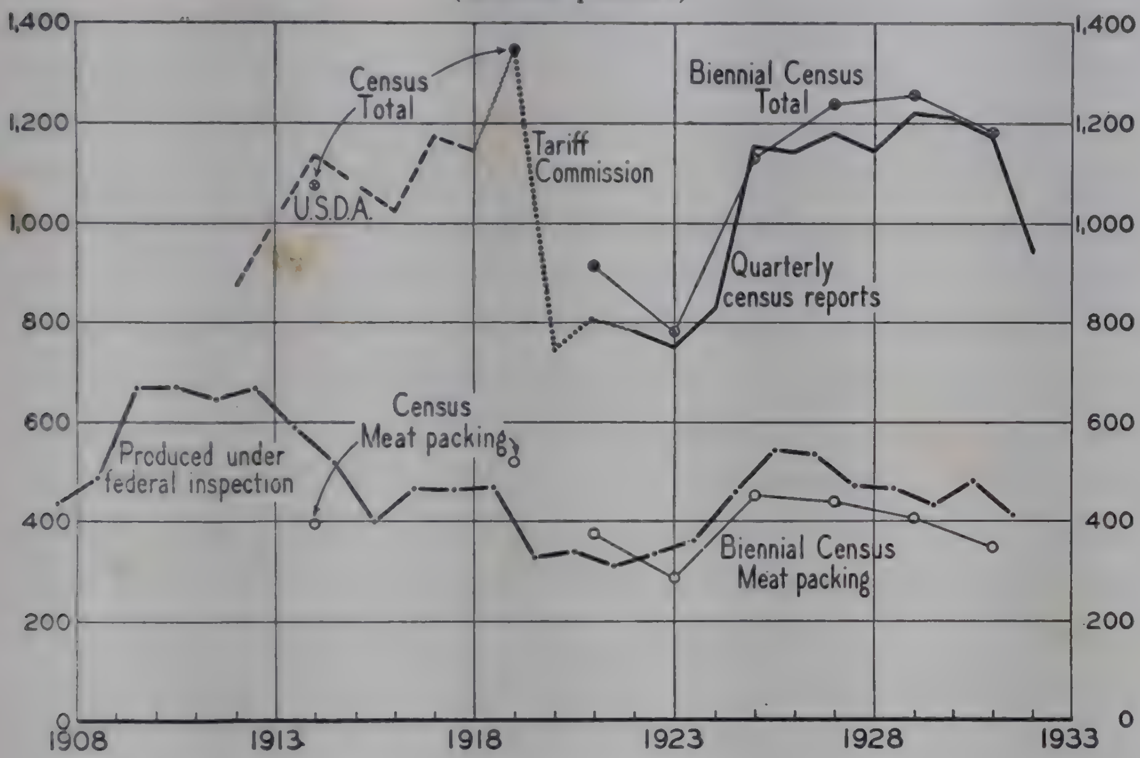
Data on total production of compound ("lard compounds and other lard substitutes") are available annually and quarterly from 1922, through quarterly reports of the Bureau of the Census on "factory production, factory consumption, and factory and warehouse stocks" of "animal and vegetable fats and oils." Quantity data gathered by the Census of Manufactures, biennially from 1925,[1] do not relate precisely to calendar years but indi-

[1] The Census of Manufactures gives value of output data for 1914 and all subsequent census years for the meat-packing industry and for other industries in two varying groups; but quantity production data are available only for the meat-packing industry for the census years 1914–23. Those, given in Table X, yield rough checks on the production estimates prior to 1925.

cate slightly larger totals for 1927 and 1929. For 1912, 1914, and 1916–18, as we have seen, there are estimates based on data gathered by the Fats and Oils Division of the United States Food Administration in surveys made in 1917–18, which were worked up by the Bureau of Chemistry of the United States Department of Agriculture. For 1919–21 the United States Tariff Commission

CHART 9.—COMPOUND PRODUCTION, 1908–32, ACCORDING TO AVAILABLE DATA AND ESTIMATES*

(Million pounds)



* Data in Table X.

has made estimates based (for 1920 and 1921) on data furnished it by manufacturers of all types. There are grounds for regarding the estimate for 1912 as too low,[1]

[1] Production of compound under federal inspection averaged 660 million pounds in 1911–12 and 1912–13, and about 105 million less in the next two fiscal years (Table X). Lard supplies for domestic use are estimated at about a pound per capita smaller for 1912 than for 1914 (Table IX). The margins between compound (and lard) prices and cottonseed-oil prices averaged about half a cent wider in 1912 than in 1914 (Tables XXII, XXIII, XXV). Exports of compound were some 4 million pounds larger in 1911–12 than in 1913–14 (Table VI). These facts all throw doubt upon the indication that compound

but the figures for 1914, 1916, and most subsequent years can probably be regarded as reasonably comparable and fairly trustworthy.[1] These various figures, together with fiscal year data on federally inspected output from 1907–08, are shown in Chart 9. It reveals a decline in output from 1914 to 1916 followed by recovery, a peak in 1919, a very low level in 1920–23, and a fairly constant level in 1925–31 not far above that of 1914.

War-Time Developments

In the first year of the World War, exports of compound to Europe increased, but the aggregate exports of 70 million pounds had been exceeded in each of the five years ending with 1910–11 (Table VI). In the next two years of the war, exports to Europe fell off greatly. In 1916–17, however, more compound was shipped to Belgium than in any pre-war year, and these shipments (presumably on Belgian Relief account)[2] rose to 14.4 million pounds in 1918 (Table VI *A*). In 1917–18, the first year of United States participation in the war, exports to the rest of Europe were very small, and those to Cuba and Mexico also fell off sharply (see Chart 7, p. 100). Total exports of compound in 1917–18 were only 31.3 million pounds, the smallest since 1900–01. In the calendar year 1918 they were 44 million, owing chiefly to increased shipments to Belgium, France, and Mexico. In this last year of the war, efforts were concentrated rather on expanding lard

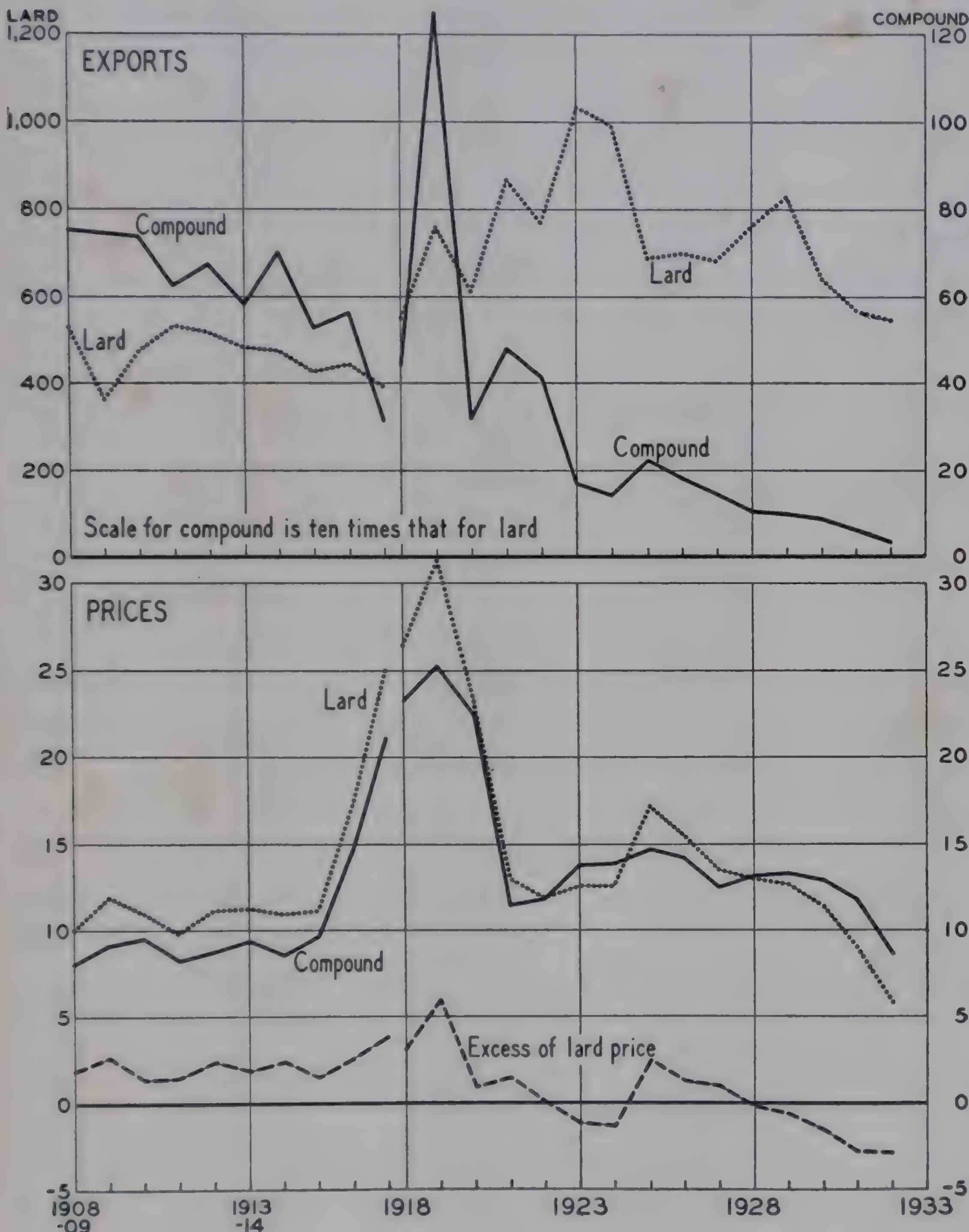
production increased by 260 million pounds (nearly a third) between 1912 and 1914, in spite of the development of hydrogenation and the marketing of new compounds (such as Crisco) containing little or no oleostearin.

[1] The Tariff Commission's estimate for 1921 is probably too low. A figure higher by over 100 million pounds is obtained if one divides the Census of Manufactures figure for total value of product by the average factory price of the portion produced in the meat-packing industry (Table XII). An even higher figure is obtained if one uses as a divisor the average wholesale price of compound reported for 1921 by the Bureau of Labor Statistics.

[2] Published statistics of the Belgian Relief Commission do not give separate figures for compound.

shipments to the allied countries; lard exports rose from 388 million pounds in 1917 to 559 million in 1918—a higher total than for any year since 1913 (Table IX).

CHART 10.—EXPORTS AND AVERAGE EXPORT PRICES OF LARD AND COMPOUND, ANNUALLY, 1908–09 TO 1932*



* Data in Table V.

The decline in exports of compound during the war was insufficient to constitute an important factor in the industry, but it is clear that war demands from foreign countries gave it no such stimulus as many other industries received.

The available statistics indicate that the output of compound in 1916 was about 110 million pounds less than in 1914, but that in 1917 and 1918 the output somewhat exceeded the 1914 level (Chart 9, p. 107). In 1914–16 the industry was presumably adversely affected by increasingly abundant supplies of lard, attributable to increasing production and reduced exports (Table IX). In 1917, however, lard production was sharply reduced, and even though exports were small, lard supplies for domestic use were much smaller per capita (Table IX and Chart 14, p. 171). Expansion of compound output thus received some stimulus, which is reflected in the statistics for 1917.

Since a supply of edible fats was of primary importance in the program of food conservation and control undertaken by the United States Food Administration, a Fat and Oils Division was organized to assume jurisdiction over all problems connected with their production, distribution, and conservation. Surveys conducted by this Division yielded the first figures on total volume of compound production to which reference has been made above.

Late in 1917, rules for the regulation of cottonseed products were promulgated by the United States Food Administration, and manufacturers of these products were put under the licensing system. These rules were aimed at hoarding, speculation, and resales. The agreements reached with the several trades involved resulted in a price stabilization for the 1917 crop. Thus the price of crude cottonseed oil at New York was fixed at 19½ cents per pound. In addition, the United States Food Ad-

ministration prescribed maximum spreads for cottonseed dealers and crushers, for refiners of oil, and for cooking-fat manufacturers. Similar action was later taken with respect to the 1918 crop. A manual of regulations under which compounders were expected to operate was issued by the United States Food Administration.[1] Exports of cooking fat, as of cottonseed oil, were put under government control, and very little of either product left the country before the Armistice. The *Annual Report of the United States Food Administration for . . . . 1918* (pp. 20–21) expressed satisfaction at the success of these measures, and pointed out that, although the farmer received approximately $10 per ton more for his cottonseed than in the preceding year, cooking fats and cottonseed meal were delivered to consumers at no greater cost than in 1917.

Wholesale consumers of shortening, such as bakers, were subject to regulations looking to conservation, especially of animal fats. In bread making, bakers were required to use vegetable shortening exclusively, while in certain other products they were permitted to use 50 per cent hog lard. The purpose of this restriction was to set free for export to Europe the maximum possible amount of lard, northern Europeans being accustomed to use lard but not compound. The amount of vegetable shortening which could be used in bread was limited to two pounds per barrel of flour. These war-time restrictions doubtless had more than a temporary effect on the market for compound, since they forced bakers to turn in part to manufactured fats, and hence to learn at first hand what could be expected of this class of shortening. In spite of these restrictions, however, the estimates of the Department of Agriculture indicate a marked increase in apparent do-

[1] *United States Food Administration Laws and Rulings, Commerce Clearing House, Chicago, New York* (Chicago, Hillison and Etten Company, 1918), p. 191. Excerpts from these regulations are reprinted in Appendix E.

mestic consumption of lard in 1918, to a per capita level (13.3 pounds) approaching those of 1907, 1908, and 1916. The lard output rose strikingly; and while exports increased by 171 million pounds, estimated domestic consumption increased by 179 million. (See Table IX.)

On the whole, the cottonseed-oil industries appear to have welcomed government control, since it brought an order and assurance into their operations which had never been attained under conditions of unrestricted competition. No doubt this was due, in part, to apparent war-time prosperity. Many were apprehensive of the effect of withdrawal of regulation, which came when the 1918 crop had been virtually disposed of, and they would have preferred to see some sort of control made permanent.

Post-War Boom and Depression

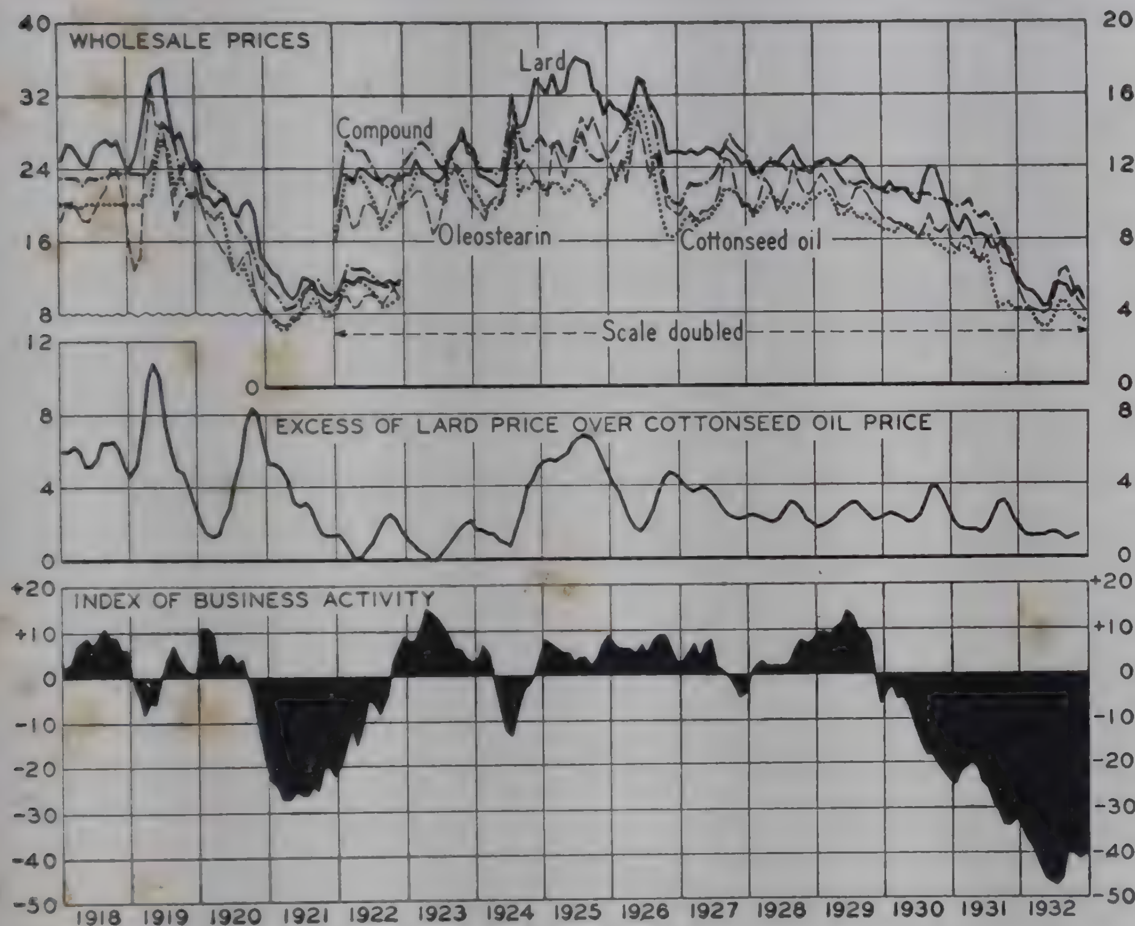
The year 1919 was a boom year in the United States, Great Britain, and various other countries, notably excluding Germany, Austria, and Russia.[1] A vigorous demand for American foodstuffs in Europe was supported by the availability of loans by the United States Government. Prices were unprecedentedly high. In many lines, domestic and export orders exceeded capacity operations, and production exceeded consumption. Exports of lard increased by 230 million pounds, leaving about a pound per capita less for domestic use. It is therefore not surprising that 1919 was marked by exceptional peaks in both production and exports of compound, and that the amount retained for domestic use (about 1¼ billion pounds) materially exceeded the total output in any preceding year.

The boom broke before the middle of 1920 (Chart 11), and the industry was plunged into depression. Exports

[1] *Business Annals*, 86, 95.

of compound fell in 1920 to 32 million pounds, a fourth as large as in 1919 and nearly as small as in 1917–18 (Chart 10, p. 109). Many business concerns were hard hit by cancellation of orders for finished products which left them with unexpectedly large stocks, and by the extreme

CHART 11.—WHOLESALE PRICES OF LARD, COTTONSEED OIL, OLEOSTEARIN, AND COMPOUND; PRICE SPREAD BETWEEN LARD AND COTTONSEED OIL; AND INDEX OF BUSINESS ACTIVITY, MONTHLY, 1918–32*



* See footnotes to Charts 2 and 4, pp. 17, 68.

price decline of 1920–21. The American Cotton Oil Company was forced to liquidate and the Southern Cotton Oil Company to reorganize. The break was so severe that the Tariff Commission production estimates of 1,350 million

pounds in 1919 and 747 million in 1920 may not overstate the decline. The extreme depression in 1921 naturally kept the output very low even though lard production was moderate, lard exports large, and cottonseed oil abundant.

The compound industry recovered more slowly than many others. As indicated by Chart 9 (p. 107), the output remained on a low level through 1924. Two important factors were mainly responsible for this protraction of depression in the industry. One was the short supplies of cottonseed oil for three years after 1920–21. The cotton crop of 1921 was very short (under 8 million bales), and those of 1922 and 1923 only around 10 million bales each. For the three years ending with 1923–24, crude cottonseed-oil production averaged only 971 million pounds, compared with the averages of 1,282 million in the three preceding years and 1,452 million in the three years before the war (Table I). Moreover, lard production was exceptionally large in 1922–24 (Table IX), and the available estimates show per capita figures of production-less-exports higher than in any preceding year for which comparable data are available (1900–21), and for 1923 and 1924 higher than in any subsequent year (Chart 14, p. 171). It is not surprising that exports of compound, which in 1922 were somewhat larger than in 1920, declined in 1923 and 1924 to lower levels than since the late 1890's (Table V).

Types of Compound Now Produced

Since the introduction of hydrogenation shortly before the outbreak of the World War, the compounds on the market have been and still are principally of three main classes. These, distinguished according to their ingredients, are: (1) mixtures of lard with other fats; (2) mixtures of vegetable oil (predominantly cottonseed oil) and hard animal fats, such as oleostearin or tallow; and (3)

cottonseed oil (or other soft vegetable oils or mixtures of oils) hardened by hydrogenation to the proper consistency unmixed with any animal fat or oil.

The first class, which was also the first to be developed as a form of adulterated lard, now has very few representatives. This is not to be interpreted, however, to mean that lard destined for local consumption and therefore not subject to the Meat Inspection Act is no longer adulterated. Such adulterated lard would appear in the statistics, as it does in commerce, simply as lard. Furthermore, the regulations for the enforcement of the Meat Inspection Act permit the addition of up to 20 per cent of oleostearin, beef fat, or mutton fat, and the sale of the mixture as lard, if the mixture is conspicuously declared on the label in conjunction with the name of the article, lard (see p. 89). Such a mixture, presumably, appears in official statistics as lard. The regulations also permit the addition of lard stearin to lard and the sale of the product simply as lard without declaration of the addition. This practice has become of importance to some Southern states where, because hogs are fattened on peanuts, much soft lard is produced.

The second and third classes are both of major importance. The proportion certainly changes from year to year, but no data available show what part of the total output each constitutes. Export data, separately available from 1922, show that vegetable oil compounds constituted more than half of the total in 1922 and 1923, and in 1928 to 1932, while compounds containing animal fats predominated from 1925 to 1927 (Table XVI); but exports are so small in relation to output that they afford no index of the proportions produced. Statistics for the shortenings (other than lard) industry, available since 1925, show the following percentages of its total output (based on Table XIII):

Class	1925	1927	1929	1931
Vegetable oils and fats only	62.7	69.3	79.1	73.0
Animal and vegetable fats and oils[a]	37.3	30.7	20.9	27.0

[a] Including compounds of the first as well as the second class above distinguished.

It is probably safe to infer that between 1925 and 1931, at least, more than half of the entire output of compound contained no animal fats and oils. In 1931, however, the proportion of the output containing animal fats and oils increased, and the census data for 1933 may show a further increase.

The third class has two subtypes which are not, however, distinguished as such by the trade. One is made by partially hydrogenating cottonseed oil (or other vegetable oil) to the desired consistency. This product is sometimes known in the trade as "all-hydrogenated vegetable shortening." The other is produced by completely hydrogenating cottonseed oil, which gives a product that is much too hard for use as shortening. This very hard product is then blended with enough cottonseed oil to give a mixture of the desired plasticity. To some extent, the hard stearin obtained as a by-product in winterizing (demargarinating) cottonseed oil is used in place of the hydrogenated oil. These products are sometimes known in the trade as "vegetable compound." The two types are chemically different; and they are said to have somewhat different properties as shortening agents, but in just what regard does not seem to have been determined by exact experiments.

In addition to the three types above listed, two other types of manufactured cooking fats have come on the market in the last few years. One is made in whole or in part from fish or whale oil by hydrogenation; the other from lard. Products containing marine oils are as yet of minor importance in the United States. The products made

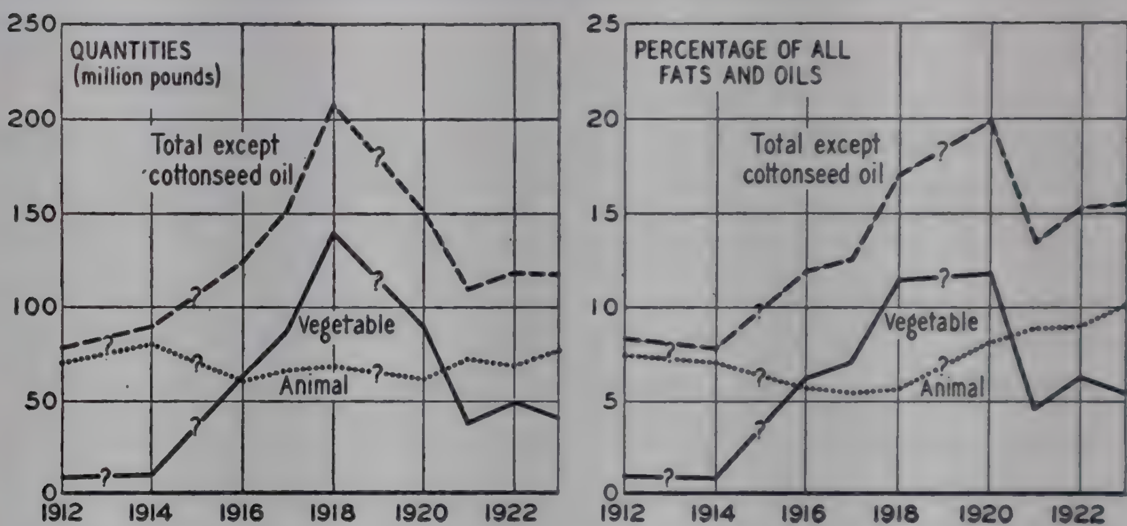
from lard, which are quite new, consist of about 95 per cent of specially treated lard and the balance is selected vegetable oil. The lard is carefully refined, deodorized, and lightly hydrogenated to a definite and constant degree. The result is a bland, uniform product with many of the traits for which vegetable shortenings are preferred to lard by certain users for certain purposes. It is, however, marketed as a shortening rather than as a brand of lard. Its introduction is so recent that no data are available as to volume of production.

Raw Materials

Throughout the war and post-war periods cottonseed oil has been by far the predominant ingredient of compound, including most of those in which more or less animal fats and oils are used. There are no consecutive figures showing the annual utilization of the several oils and fats in the manufacture of compound, and those for certain years are not wholly satisfactory. Table XVII presents the Tariff Commission's recent assembly of such data and estimates as it could find, using the Department of Agriculture's data for 1912, 1914, and 1916–18, its own estimates for 1920–23 and for 1929—the latter based on a special report of the Census of Manufactures on the consumption of the various oils in specified industries. To these are added the Census Bureau figures for 1931–33. According to these figures, cottonseed oil constituted around 92 per cent of the total materials in 1912 and 1914; the proportion declined to 80 per cent in 1920; and in subsequent years for which percentages are given it has ranged from 76.9 to 88.8 per cent. The proportion may have been higher in some years not shown; it is probably safe to assume that at least in the year following the bumper cotton crop of 1926 cottonseed oil constituted over 90 per cent of the total.

Chart 12 shows graphically the corresponding amounts and percentages of other vegetable oils and animal fats and oils used in the manufacture of compound, in total and in two groups, for the available years in the period 1912–23. In the main, the indications that it gives seem reasonably trustworthy for the specific years shown, but no inference can safely be drawn for the years omitted.

CHART 12.—FATS AND OILS (OTHER THAN COTTONSEED OIL) USED IN MANUFACTURE OF COMPOUND, 1912–23*



* Data in Table XVII.

The proportion of animal fats and oils used, as indicated by these figures, has varied only from 5 to 10 per cent of the total. It apparently declined somewhat during the war years, and then rose from 1918 to 1923. In 1931 the proportion of animal fats and oils reached 11.1 per cent, but declined in 1932 to 8.6 per cent (Table XVII). Vegetable oils other than cottonseed oil were of negligible importance in compound manufacture in 1912 and 1914, but became increasingly important during the war. The high level of 1918 was slightly exceeded in 1920, when the percentage reached nearly 12 per cent. In the next three years the percentage was much lower; in 1929 it may have fallen below 2 per cent. In 1931 other vegetable oils again

became important, when the proportion reached 12 per cent, but in 1932 it fell to 5.2 per cent.

The percentages of the total ingredients of compound represented by various animal fats and oils, as shown by the estimates mentioned above, are as follows (quantities in Table XVIII):

Year	Tallow, edible	Oleo-stearin	Oleo oil	Pork fat and lard	Fish oils
1912......	1.1	6.1	...	0.2	...
1914......	1.3	5.6	...	0.1	...
1916......	0.9	4.7	...	0.1	...
1917......	0.8	4.5	...	0.1	...
1918......	0.9	4.5	...	0.2	...
1920......	1.3	5.5	...	1.3	...
1921......	1.2	5.7	0.1	1.8	...
1922......	1.4	5.7	0.4	1.5	...
1923......	3.1	5.7	0.4	0.9	...
1929......	2.1	3.6	0.6	1.9	1.2
1931......	5.8	2.2	0.8	0.7	1.6
1932......	4.7	1.8	0.1	0.6	1.4
1933......	4.8	1.8	0.0	0.3	1.0

Among animal ingredients of compound, oleostearin has been the most important (except in relatively unimportant products which make use of mixtures containing hog fat), until 1931. For the industry as a whole, in years for which data are available between 1912 and 1923, oleostearin constituted from 4.5 to 6.1 per cent of all fats used, the lower limits of the range occurring during the war. In recent years, to judge by data for 1929 and 1931–33, its use in compound has considerably declined. Edible tallow, which is used interchangeably with oleostearin as a hardening agent, was taken by the industry in small amounts prior to 1923, when it constituted some 3 per cent of all ingredients. In 1931 and 1932, it constituted

over half of all animal and fish oils and fats used, and nearly 5 to 6 per cent of the total materials of compound. The combined consumption of oleostearin and tallow by the industry appears to have accounted for 5.3 to 8.8 per cent of the total materials in the years for which data are available, the proportion being near the lower limit of the range during the war and 1929, but near the upper limit in 1923 and 1931. It is pointed out below (pp. 129–30) in the discussion of the use of coconut oil that in recent years oleostearin has tended to be relatively low in price, both because as a by-product of margarine manufacture it has tended to be available in increasing amounts and because hydrogenated oils can be substituted for it. When it (or the oleo stock, the fat from which it is derived) is lower in price than hydrogenated cottonseed oil, there is a tendency toward increased use of hard animal fats in compound. Such a price relationship, naturally, is most likely to occur in years when margarine production is small and cottonseed-oil prices are high, as in 1922 and 1923. In those years, there was increased use of animal hardening agents in compound. These two years represent the low point for margarine production in the post-war period. In so far as margarine in these years absorbed a smaller volume of animal fat than theretofore, the position of this raw material of the compounder was weakened with corresponding encouragement to its use in compound. The observed shift from oleostearin to tallow may be explained in part by the level of margarine production, the absolute and relative utilization of oleo oil in margarine production, and the resulting effects on the prices of tallow in relation to the prices of oleostearin. Margarine production was not large in 1930–31, and in 1931–32 it was nearly as low as in 1922 and 1923. Oleo oil used in the preparation of margarine was smaller, both absolutely and relatively, in 1930–31, than in any year since 1915–16,

and it declined still further in 1931–32. Supplies of oleostearin available to compounders were curtailed; prices of tallow were unusually low in relation to prices of oleostearin. It was advantageous to substitute tallow for its derivative, oleostearin.

However, in 1922 and 1923, there was a far more important reason than the availability of hard animal fats for the extensive use of these fats in compound. The cotton crops of 1921, 1922, and 1923 were short, with a consequent sharp decline in the output of cottonseed oil in the crushing years of 1922, 1923, and 1924. At the same time, there was a reversal of the usual price relationship between lard and cottonseed oil. Moreover, prices of the latter ruled higher than those of oleostearin during most of 1922 and 1923 (Chart 11, p. 113). It is no wonder, then, that relatively more animal fat was used in compound in those years than previously.

The census figures for 1929 show a decline in the relative use of edible tallow and particularly of oleostearin, which constituted a smaller percentage of total materials than for any year previously reported. But even the census figures for 1929, while showing a smaller relative utilization of these two fats than the Tariff Commission's estimate of 1920 to 1923, indicated a level slightly higher than that in the years 1916, 1917, and 1918. Prior to 1914, of course, the commercial application of hydrogenation was not very widespread, so that it is not unexpected to find a drop in the utilization of animal hardening agents between 1914 and 1916.

On the whole, the use of hard animal fat in compound has maintained itself astonishingly well in the face of the competition of hydrogenated oils. Perhaps the reason is that hard animal fats, being by-products of cattle slaughter, must be disposed of for low-grade technical uses, if they are not used in compound or margarine. However,

as will appear below, the competition of hydrogenated oils is making itself felt, in that purely vegetable compound in recent years has shown a marked gain in volume of production, both absolutely and in comparison with the production of the mixed animal and vegetable product. The reversal of this tendency shown by statistics for 1931 is probably temporary.

The drop in the relative price of hard animal fats had certain repercussions on hydrogenation. Before that drop, hydrogenation of oils was practiced as a side line by certain concerns manufacturing chlorin and caustic soda by the electrolytic process in which hydrogen is a waste product. The cost of hydrogenation has two components: (1) the cost of the conversion itself, which is somewhere around ¼ cent a pound on the finished fat, and (2) the cost of the hydrogen, which is about as much more. Obviously, a concern producing hydrogen as a waste product should have a decided advantage. And so, in the beginning of hydrogenation in America, this process was practiced in several locations where cheap water power was available for the generation of electricity, since it is in such places that chemical works for the electrolytic production of chlorin and caustic soda are preferably located. Thus, among the early hydrogenating concerns was the Brown Company of Berlin, New Hampshire, primarily paper and pulp manufacturers. Another concern was located in Buffalo, where hydrogen could be obtained cheaply from the local electrolytic plants using current generated at Niagara Falls. Other hydrogenating plants were also established at Cincinnati and elsewhere. Some of these concerns prospered for a while, but nearly all of them dropped out of business when the price of oleostearin fell below the cost of hydrogenated oil. For the last eight or ten years, hydrogenation has been practiced almost exclusively by manufacturers of shortening com-

pounds, but some hydrogenated fat is now being sold to smaller compounders for hardening purposes.

In this connection, it is interesting to note that hydrogenation of whale and fish oils was practiced as early as 1911 in Norway, where there is very cheap water power at the seaboard, and where the fisheries are important. At least one Norwegian company carefully surveyed the American market as a possible outlet for hydrogenated herring oil, but the war interfered with its plans. In America, the use of fish oil in compound was first developed on the Pacific Coast during the war. California is at present an important state in the production of fish oils, and Monterey is the most important fishing town, largely because of the heavy catch of sardines. Only a portion of the catch is suitable for canning, because the fish run too large. Great quantities of the large fish are worked up for oil and meal, the latter being used for chicken and stock feed and at times for fertilizer. A certain amount of sardine oil is also obtained as a by-product in canning from the material discarded when the fish are decapitated, and also from the liquor which is drained off from the fish after they have been cooked. This liquor is passed through a centrifuge of the cream-separator type.

There is little information available regarding the use of fish oil, for this ingredient was not included among those reported by the United States Tariff Commission's study of raw materials of this industry. Manufacturers are reluctant to reveal any information which might, if it became generally known, prejudice consumers against their product. In this country, at least, there would undoubtedly be a prejudice among housewives against shortening made of fish oils, although its use has gained some importance in margarine and cooking fats in northern Europe, especially in Scandinavian countries.

For 1929, the Bureau of the Census reports the use of about 15 million pounds of fish oil in compound, or 1.2 per cent of all ingredients. For 1931, the amount and percentage were a little larger, some 19 million pounds, and 1.6 per cent; for 1932, the amount was a little smaller, 14 million pounds, but the percentage was slightly higher than for 1929, 1.4 per cent. Evidently some manufacturers have found the use of small quantities of this oil advantageous, or at least are experimenting with it with the view to adding it to their list of available materials. However, the compound made with fish oil in southern California is said to be of rather poor quality and to be sold at a low price. There seems to be no reason why hydrogenated fish oils may not gain an increasing place in edible products in this country as well as abroad. Indeed, there is no reason why whale oil should not be used for these purposes;[1] it is so used abroad. Large quantities are being imported into the United States for soap. Whale oil is produced extensively by Norwegian companies operating in part with British capital and hunting in Antarctic waters. At the present time, these operations have been restricted greatly because of the very low price level of fats in general.

Manufacturers of compound, as well as of other products of fats and oils, have come in recent years to use larger quantities of a wider variety of vegetable oils other than cottonseed oil than they did before the war. These figures put together by the Tariff Commission and the Bureau of the Census, summarized in Table XVIII, show the following details in percentages of the total ingredients of compound:

[1] It is perhaps unnecessary to point out that the Meat Inspection Act applies only to cattle, sheep, swine, goats, and horses, and that, therefore, marine oils, though of animal origin, and compounds made from them are not subject to the restrictions of that act. They can be manufactured and shipped in interstate commerce like vegetable shortening.

Calendar year	Peanut oil	Soy bean oil	Corn oil	Coconut oil	Unspecified oils
1912	0.2	...	...	...	0.7
1914	0.2	0.1	...	...	0.5
1916	1.7	1.4	1.3	...	1.8
1917	1.0	2.8	0.3	0.5	2.5
1918	2.3	4.6	0.2	1.1	3.2[a]
1920	6.4	2.3	0.9	1.3	0.9
1921	1.9	1.0	0.4	0.4	0.9
1922	1.3	...	1.8	2.1	1.1
1923	0.5	0.1	0.9	2.8	1.1
1929	...[b]	...	...[b]	1.6[c]	0.1[d]
1931	0.5	0.9	0.6	2.8	7.2[e]
1932	0.4	0.5	0.3	0.8	3.2[e]
1933	0.3	0.0	0.1	0.7	3.2[e]

[a] Including 1.5 per cent representing largely "hydrogenated oils purchased by the smaller substitute makers for combining with other ingredients." Corresponding figures for 1914, 1916, and 1917 hardly affect the percentages shown.

[b] "Peanut and corn oils shown by the Bureau of the Census as used in 1929 in food industries other than the margarine industry were regarded as used solely in making salads and table oil. This involves a slight error, for it is probable that small but indeterminate quantities of these oils were used in lard compounds."

[c] "From the quantities of coconut and palm-kernel oils shown by the Bureau of the Census as consumed in 1929 in food industries other than margarine, there were deducted sales of these oils to the confectionery and baking trades by six leading refiners. The remainder, which is the figure given, is probably only a slight overstatement of the consumption of those oils in lard compounds."

[d] Including chiefly palm oil. "Palm oil shown by the Bureau of the Census as used in 1929 in food industries other than the margarine was taken as used entirely in lard compounds. An estimate made by one of the leaders in the trade showed 10,000,000 instead of a little over 1,000,000 pounds." See further footnote *d* of Table XVIII.

[e] Including the following percentages for the years indicated:

Year	Palm oil	Sesame oil
1931	2.7	2.6
1932	2.3	0.8
1933	2.2	0.8

During and immediately following the war, the use of peanut oil and soy bean oil increased temporarily. The former constituted as high as 6.4 per cent of total ingredients in 1920, or slightly more than oleostearin in that year. In 1918, soy bean oil constituted nearly 5 per cent of all raw materials used in the industry. After 1920, the im-

portance of both oils in the manufacturing of shortening declined, and the 1929 census figures indicate negligible use of these ingredients, if, indeed, any was used in the compound industry proper.

Imports of both oils were very large in 1919, and still heavy in 1920; but the onset of business recession caused sharp reductions in the second half of 1920. Importations were very low when heavy duties came into force on these oils on May 28, 1921, under the Emergency Tariff Act (see Table XIX). These duties, of which one was increased and the other (on soy bean oil) only slightly lowered under the Tariff Act of 1922, doubtless helped restrain the expansion of imports when business revived. In subsequent years peanut oil imports (less re-exports) have in no year exceeded 8 million pounds. Soy-bean-oil imports (less re-exports) did not fall so low, but the maximum since 1920 was only 41.5 million pounds, and the average for 1921–29 was under 20 million pounds. After 1929 soy-bean-oil imports (less re-exports) declined substantially, to 4 million pounds in 1931 and to 2 million pounds in 1932. These were slightly less than domestic exports, which amounted to nearly 5 and 3 million pounds in 1931 and 1932 respectively. The increase in the duty under the Tariff Act of 1930, by about 1 cent a pound, was probably a factor.

The use of coconut oil in compound has apparently been on a higher level in the past decade than in earlier years. Though coconut oil has been subject to a heavy duty since May 28, 1921 (Table XIX), this has not applied to imports from the Philippines, and copra has been duty-free. The Tariff Commission's data or estimates of consumption of coconut oil 1922–30 are as follows, in million pounds:[1]

[1] U.S. Tariff Commission, *Report to the Congress on Certain Vegetable Oils, Whale Oil, and Copra* (1932), p. 90. Including our arithmetical corrections.

Year	In lard substitute	In margarine	In soap	In three industries	In all industries	Unaccounted for
1922	16.1	57.4	237.7	311.2	383.6	72.4
1923	21.2	75.9	268.0	365.1	445.4	80.3
1924	20.0	83.3	260.0	363.3	396.0	32.7
1925	20.0	90.9	286.0	396.9	428.3	31.4
1926	20.0	97.6	270.2	387.8	452.2	64.4
1927	20.0	122.6	334.8	477.4	540.6	63.2
1928	20.0	159.9	335.4	515.3	574.0	58.7
1929	20.0	185.5	393.9	601.4	662.0	60.6
1930	20.0	178.0	303.3	501.3	661.4	160.2

Coconut oil is generally lower in price than cottonseed oil; but compound manufacturers have not followed the lead of the margarine and soap trades in using the oil much more heavily in recent years. Thus in 1912, coconut oil constituted 0.4 per cent of the fats used in margarine, but, in 1930–31, it reached 65.7 per cent and in 1931–32, 71.0 per cent. At the same time, cottonseed oil dropped from 26.8 per cent of the total in 1912 to 9.3 per cent in 1930–31 and 8.3 per cent in 1931–32. Not quite so impressive is the record of coconut oil in the soap industry. Its use rose from 10.6 per cent of all fats used in 1912 to 20.3 per cent in 1929, whereas cottonseed oil and cottonseed-oil foots dropped from 29.8 to 7.1 per cent during the same period.[1] In contrast with the shifts to coconut oil in soap and margarine, the utilization of coconut oil in compound is small. The addition of a little coconut oil to the oil to be hydrogenated improves the flavor,[2] but its presence in amounts exceeding 8 to 10 per

[1] *Ibid.*, 34, 150, 152; see also U.S. Tariff Commission, *Certain Vegetable Oils. Part 2, Economic Study of the Trade in and the Prices and Interchangeability of Oils and Fats* (1926), 163, 169; Commissioner of Internal Revenue, *Annual Report, 1931*, p. 145. The decrease of cottonseed oil in margarine is probably due in part to the fact that it is not a nut oil and cannot, therefore, be used in margarines that are represented as being made wholly from nuts. Most of the cottonseed oil now used in soap is foots. The 1929 census figures, quoted here, class cottonseed-oil foots as primary oil used by the soap industry.

[2] Carleton Ellis, *The Hydrogenation of Oils* (New York, Van Nostrand, 1919, 2d edition), 436. Hydrogenated mixtures of coconut oil with peanut oil are

cent causes foaming in deep frying.[1] For this reason, such compounds are unsatisfactory for frying doughnuts, Saratoga chips, French-fried potatoes, and the like. Compounds containing large amounts of coconut oil cannot, therefore, be sold to the household trade which demands a general-utility cooking fat. In margarine, in which coconut oil is used so extensively, foaming is not objectionable, since margarine is not used in deep frying. Moreover, this property may even be an advantage since butter used in pan-frying spatters and foams and it is with butter that margarine competes—at least in the United States. Furthermore, it is stated that it is unsatisfactory to use large proportions of coconut oil in compound because this oil has a relatively low shortening power. However, the writers have been unable to find a record of any adequate experimental investigation of this question.

If any way is devised to eliminate foaming, the future may see greatly increased use of coconut oil in compound. It is said that it does not foam when it is unmixed with other oils; but so far as is known no cooking fat composed entirely of coconut oil has been produced commercially in the United States. In Germany, such products are on the market. In their manufacture, pure coconut oil is manipulated mechanically, so as to give it a greater degree of plasticity than that of the unworked oil. Coconut oil, as such, may very well in the future become a cooking fat in the United States, as it is over much of the tropics, though it is hardly plastic enough for general use as a shortening. Production of copra in the trop-

---

much used as an ingredient of vegetable margarine, both because of this flavor and texture.

[1] This is the case with unhydrogenated coconut oil. The writers are not acquainted with any evidence to the effect that hydrogenated coconut oil behaves in the same way. If it is true, as has been suggested, that coconut oil smokes because it contains some fatty acids of comparatively low molecular weight (lauric and myristic acids), then hydrogenation should have little effect.

ics is capable of considerable expansion at moderate cost.[1]

The growing use of coconut oil in the United States has had effects upon the compound industry greater than are represented by its limited use in compound. The extensive displacement of cottonseed by coconut oil in margarine and soap, above noted, has set cottonseed oil free for use in compound and in other products. This has, perhaps, been a potent factor in determining that compound should remain the principal outlet for cottonseed oil. Moreover, the increasing use of coconut oil by the margarine industry has probably made the demand of that industry for hard animal fats less insistent than it might otherwise have been, and to that extent, coconut oil may have made such fats more accessible to compounders. From 1912 to 1929, the production of margarine rose from 128.6 million to 342.2 million pounds. In 1912, animal fats other than lard constituted 45.5 per cent of all fats used in margarine, whereas in 1928–29 these fats constituted but 20.6 per cent.[2] Since 1929, margarine production has fallen to 215.3 million pounds in 1931–32, and in that year animal fats other than lard constituted 12.4 per cent of all fats used. The place of these animal fats has been taken largely by coconut oil. In short, if it had not been for coconut oil, in recent years, considerable quantities of animal fats might have been absorbed in the margarine industry rather than in the manufacture of compound. The growth of the margarine industry did not cause much, if any, competition for hard animal fats between compounders and margarine manufacturers, as witnessed by the fact that since the war there has been a tendency for oleostearin to be low in

[1] K. Snodgrass, *Copra and Coconut Oil* (Fats and Oils Studies of the Food Research Institute, No. 2, April 1928), 116–17.

[2] Commissioner of Internal Revenue, *Annual Reports*, and Tariff Commission reports cited above.

price. The reasons for this tendency are discussed below (pp. 142, 201).

Until very recently, peanut, coconut, corn, and soy bean oil were virtually the only vegetable oils, other than cottonseed oil, used in American compound. Of these, soy bean oil is not so satisfactory as cottonseed oil, because it is difficult to refine so as to make it permanently white and bland in flavor. Within the last two or three years, palm oil, sunflower oil, and sesame oil have also begun to be used.[1]

In 1929 at least 1.2 million pounds of palm oil (and possibly several times as much) were used in compound; and in 1931 and 1932 the corresponding figures were 34.5 and 22.1 million pounds (Table XVIII, footnotes *d*, *e*, and *f*). This oil is free of duty; large and increasing quantities have been imported for years for use in the manufacture of tinplate and of soap. Before the war, this oil came almost exclusively from West Africa, where it is produced mostly by natives. Its quality was poor, and it is difficult to refine and deodorize.[2] Since the war, the situation has changed because the oil palm has been grown successfully on plantations in Sumatra and British Malaya. The oil there produced is of high quality and easily rendered edible. Some of it has been imported in steamers provided with tanks. It is being used by a few producers of compound, especially on the Pacific Coast. For the lower grades, it can be used up to about 40 per cent. It does not require hydrogenation, and, mixed with unhardened cottonseed oil, it makes a product of good consistency. It is possible that future improvements in refining methods may result in making it usable to a larger extent and in the better grades.

[1] U.S. Tariff Commission, *op. cit.* (1932), 40, and Table XVIII.

[2] However, as early as February 17, 1914, a patent for the use of hydrogenated palm oil in edible-fat products was granted to Carleton Ellis (U.S. Patent No. 1087161).

In 1931, 33.8 million pounds of sesame oil were used in lard compounds, and in 1932, the corresponding figure was 7.8 million pounds (Table XVIII, footnotes *e* and *f*). The principal countries of export of the seed are India and China, whereas Holland and the United Kingdom are the largest exporters of oil. During recent years, the low price of silver and the favorable exchange have stimulated importations of seed from China, especially on the Pacific Coast. This oil, formerly free of duty, is subject under the Tariff Act of 1930, if edible, to a duty of 3 cents a pound (Table XIX). Importations of oil have become negligible,[1] since the seed, being free of duty, is imported for crushing instead.

An oil that may be important in the future is palm kernel oil, which so closely resembles coconut oil that even chemists find difficulty in telling the two apart. Whether it is subject to the same limitations as coconut oil when used in compound is not known to the writers. It has been extensively used in margarine in Europe. The United States Tariff Commission in its recent report states that it has been used to a slight extent in compound in the United States.[2] Up to 1922, palm kernel oil was ordinarily cheaper than coconut oil, but since 1923 the latter has been cheaper.[3] Though the two oils are interchangeable over a wide range of uses, American manufacturers have preferred coconut oil, except for a few special uses. Before the war, Germany used 25,000 tons of palm kernel oil in margarine out of a total of 125,000 tons, of which only 40,000 tons were made edible.[4] Some was used as a cooking fat in the manner above described

[1] U.S. Tariff Commission, *op. cit.* (1932), 27.

[2] *Ibid.*, 40.

[3] *Ibid.*, 184.

[4] E. W. Thompson, *Cottonseed Products and Their Competitors in Northern Europe. Part II, Edible Oils* (U.S. Department of Commerce, Special Agent Series 89), 1914, pp. 7, 25.

for coconut oil (see p. 128). So far as its physical and chemical characteristics are involved, it is capable of playing a rôle in compounds similar to that of coconut oil (see p. 128). Its importation into the United States was very limited between 1915 and 1924, but reached a peak of 75 million pounds in 1926. In 1930, the imports dropped to 29 million pounds. In that year, a duty of 1 cent a pound was imposed upon the edible product, but, if inedible (denatured), it is free.[1] In 1932, imports of both edible and inedible palm kernel oil fell to 2.1 million pounds.

As far as flavor and other characteristics are concerned, corn (maize) oil offers a satisfactory material for compound and has been used to a small extent. Its supplies, however, are extremely limited and its price is almost uniformly above that of cottonseed oil. For these reasons, corn oil offers little competition to cottonseed in the compound industry, although as a salad oil, and for use in mayonnaise, it constitutes an appreciable part of the total oils used for these purposes.[2] Its predominant use in these ways results from the fact that it is mostly a by-product of wet-corn milling and its supply is, therefore, largely controlled by the corn-starch factories. This industry has pushed its sale as a salad and cooking oil in retail packages under brand names by extensive national advertising.

While it is clear that the several vegetable and animal fats other than cottonseed oil which make a modest contribution to the raw materials of the compound industry are capable of greater utilization under favorable cir-

[1] U.S. Tariff Commission, *op. cit.* (1932), 96, and Table XIX.

[2] No figures are available showing the consumption of the several oils, mostly cottonseed and corn oil, in the commercial manufacture of salad oils and mayonnaise. Production of crude corn oil amounted to nearly 134 million pounds in 1929; refined corn oil production in the same year amounted to some 121 million pounds, of which nearly all was consumed in food products.

cumstances, there are several factors in addition to those already mentioned which have operated to fortify and maintain the present paramount position of cottonseed oil in the industry. A number of leading producers have developed special brands to meet specific trade requirements or preferences, and have worked out standards of performance which are important to maintain. In consequence, there is less tendency than might be expected to vary formulae and processes to take advantage of temporary changes in price relationships. Furthermore, the very dominance of cottonseed oil as a major ingredient has resulted in a close identification of the cottonseed-oil interests with those of the compound industry, with a consequent disposition on the part of the former to utilize the latter as far as possible as a medium of distribution for their refined oil.

A new element in the situation has, temporarily at least, been introduced with the Agricultural Adjustment Act, passed in May, 1933, which provides for substantial reduction in cotton acreage. This will, under present methods, mean an almost equivalent decrease in the output of cottonseed oil,[1] and will result in either a considerable decline in the production of compound or a shift to other raw materials. In view of the fact that lard production will also presumably be curtailed under the operation of the act, and its price probably enhanced, it seems reasonable to anticipate that the second alternative will be chosen.

[1] Some seed now reserved by the farmers might be released for crushing if they would adopt the practice of planting delinted seed, which germinates much better, and if the practice of using seed for fertilizer were entirely discontinued. It is estimated that about 20 per cent of the seed crop is held by farmers for these two purposes, approximately half for each. A recent bulletin of the U.S. Department of Agriculture (J. E. Barr, *Delinting and Recleaning Cottonseed for Planting Purposes* [U. S. Department of Agriculture Department Bulletin No. 1219], April 1924) strongly recommends the planting of seed from which about 150 lbs. per ton of linters has been cut. It has been estimated that at least 20 pounds of seed per acre could be saved by planting delinted seed.

If the curtailment in cottonseed-oil output results in a higher price for this oil, there will be a double incentive to use greater quantities of other fats. Packer compounders, in particular, will be likely to make more extensive use of animal fats, especially since tallow and oleostearin, the principal animal ingredients of compound, are derived from cattle, which are not subject to control under the act. Even vegetable-oil compounders, many of whom represent one branch of an integrated cottonseed-oil industry, will probably be inclined to resort to a more extensive use of other fats and oils, in order to maintain a fair volume of output so as to safeguard as far as possible their position in the industry. If they choose to maintain output of a purely vegetable product they will have the choice of both domestic and imported vegetable oils. To the extent that the act, through its effect on the supply of the two great American cooking fats, lard and cottonseed oil, succeeds in raising the domestic price level of such fats there will result a tendency toward larger importation of suitable vegetable oil materials. Higher domestic prices will reduce the effectiveness of existing tariff rates on vegetable oils, since they are virtually all specific rather than *ad valorem* duties. One of the first effects of the restriction on cotton production, so far as it concerns vegetable oils, may, therefore, be an increase in imports of such oils for use in compounding.

Apart from changes resulting from the act, which may prove only temporary, the future may see pronounced shifts in the materials used in shortening. Technical and economic changes have produced such shifts in the past; they will doubtless do so in the future. Certainly, cottonseed oil will be supplemented in this industry in increasing amount by other fats, if its supplies prove inadequate to meet the requirements of its current outlets. In addition, it may find itself supplanted to some extent, if

chemistry and industry combine to bring forth another fat as satisfactory in performance and more cheaply produced. Such developments are not yet in sight.

Production by Classes of Manufacturers

We have already seen that the production of compound from its earliest years has been divided mainly between two groups of producers, those engaged primarily in production and marketing of animal products,[1] and those engaged in the crushing or refining of cottonseed oil. The immediate economic setting of the two groups is different in a number of respects and warrants their separate consideration in census returns. A less important group includes those concerns for whom compound is not the principal product in point of value. The census probably includes in this group some large producers of compound that are also important soap or soap-powder manufacturers.

The census data given in Table XII show that in the census years 1914, 1919, and 1921, and again in 1925, roughly two-fifths of the output of compound was produced by the slaughtering and meat-packing industry; but that the proportion declined in subsequent census years to less than one-third in 1931. The great bulk of the rest, and well over half of the total, at least since 1925, has been produced by what may be briefly termed the shortenings (other than lard) industry. Some establishments included in this group are subsidiaries of larger companies whose major activities are not concerned with the production of compound. Changes in census classifications make impossible accurate comparisons of the compound output of this branch of the industry with that of other pro-

[1] In the early years, this group included not only slaughterers and meat packers, but also independent lard refiners. The latter have dropped out of the picture and have not been reported separately in census returns since 1909.

If the curtailment in cottonseed-oil output results in a higher price for this oil, there will be a double incentive to use greater quantities of other fats. Packer compounders, in particular, will be likely to make more extensive use of animal fats, especially since tallow and oleostearin, the principal animal ingredients of compound, are derived from cattle, which are not subject to control under the act. Even vegetable-oil compounders, many of whom represent one branch of an integrated cottonseed-oil industry, will probably be inclined to resort to a more extensive use of other fats and oils, in order to maintain a fair volume of output so as to safeguard as far as possible their position in the industry. If they choose to maintain output of a purely vegetable product they will have the choice of both domestic and imported vegetable oils. To the extent that the act, through its effect on the supply of the two great American cooking fats, lard and cottonseed oil, succeeds in raising the domestic price level of such fats there will result a tendency toward larger importation of suitable vegetable oil materials. Higher domestic prices will reduce the effectiveness of existing tariff rates on vegetable oils, since they are virtually all specific rather than *ad valorem* duties. One of the first effects of the restriction on cotton production, so far as it concerns vegetable oils, may, therefore, be an increase in imports of such oils for use in compounding.

Apart from changes resulting from the act, which may prove only temporary, the future may see pronounced shifts in the materials used in shortening. Technical and economic changes have produced such shifts in the past; they will doubtless do so in the future. Certainly, cottonseed oil will be supplemented in this industry in increasing amount by other fats, if its supplies prove inadequate to meet the requirements of its current outlets. In addition, it may find itself supplanted to some extent, if

chemistry and industry combine to bring forth another fat as satisfactory in performance and more cheaply produced. Such developments are not yet in sight.

Production by Classes of Manufacturers

We have already seen that the production of compound from its earliest years has been divided mainly between two groups of producers, those engaged primarily in production and marketing of animal products,[1] and those engaged in the crushing or refining of cottonseed oil. The immediate economic setting of the two groups is different in a number of respects and warrants their separate consideration in census returns. A less important group includes those concerns for whom compound is not the principal product in point of value. The census probably includes in this group some large producers of compound that are also important soap or soap-powder manufacturers.

The census data given in Table XII show that in the census years 1914, 1919, and 1921, and again in 1925, roughly two-fifths of the output of compound was produced by the slaughtering and meat-packing industry; but that the proportion declined in subsequent census years to less than one-third in 1931. The great bulk of the rest, and well over half of the total, at least since 1925, has been produced by what may be briefly termed the shortenings (other than lard) industry. Some establishments included in this group are subsidiaries of larger companies whose major activities are not concerned with the production of compound. Changes in census classifications make impossible accurate comparisons of the compound output of this branch of the industry with that of other pro-

[1] In the early years, this group included not only slaughterers and meat packers, but also independent lard refiners. The latter have dropped out of the picture and have not been reported separately in census returns since 1909.

ducers; but it seems evident that the production by concerns not identified with one of the two major branches of the industry has shrunk to very small proportions.

Compound manufacturers may also be classified according as they operate under or outside federal inspection. For the federally inspected production, there are trustworthy data which are presented in Table X. Since these are reported for fiscal years, whereas census reports and estimates of production for years prior to 1922 are on a calendar-year basis only, the first period which can be made exactly parallel is the fiscal year ending June 30, 1923. According to the figures summarized below in million pounds, the production of compound under federal inspection has varied from 36 to 47 per cent of

Year July–June	Total output[a]	Federally inspected[b]	Percentage federally inspected
1922–23	792.9	336.8	42.5
1923–24	766.9	363.2	47.4
1924–25	981.8	458.5	46.7
1925–26	1,201.6	543.9	45.3
1926–27	1,161.9	535.2	46.1
1927–28	1,142.1	472.6	41.4
1928–29	1,176.6	467.1	39.7
1929–30	1,205.7	433.5	36.0
1930–31	1,228.2	482.5	39.3
1931–32	1,033.5[c]	411.9	39.9

[a] From quarterly returns to the U.S. Census Bureau and published in *Animal and Vegetable Fats and Oils Production, Consumption, Imports, Exports, and Stocks* and *Statistics of Fats and Oils.*

[b] As given in Table X.

[c] Preliminary.

the aggregate output in the ten years. The high point of production in inspected plants for the 10-year period ending June 1932 came in 1925–26. In this and the following year, the output of such plants was greater than for any year since 1914, shortly after the successful commercial application of hydrogenation to the production of compound. In the four fiscal years, 1924–27, the percentage

of total output accounted for by inspected plants was likewise above the level of that obtaining in all years subsequent to 1914 for which we have data. Since 1926–27, the production of compound in such plants has declined both absolutely and relatively. Indeed, there is indication that the tendency of output in inspected plants is to continue its relative decline, although the period of adequate statistics is too short to justify any positive assertions on this point. Movement in this direction, however, is what would be expected in the face of an increasing per capita consumption of shortening, and a declining per capita slaughter of cattle,[1] at least in inspected plants.

While production under federal inspection is principally in meat-packing establishments, it is obvious that a portion must be in other establishments which buy animal fats, for the figures for production in federally inspected plants are larger than the figures for production in all meat-packing and slaughtering establishments, whether inspected or not, as reported by the census. The difference between the two might be taken to represent the volume of compound made under inspection in establishments not classed by the census as meat-packing

[1] The reasons for the relative increase in the production of compound in inspected plants in the middle 1920's are somewhat obscure, but partial explanation may be found in the increased federally inspected slaughter of cattle at this time and a moderate gain in oleostearin output.

The slaughter of cattle in federally inspected plants for the fiscal years 1925 and 1926 exceeded 10 million animals. Only during the war years has the annual federally inspected slaughter reached this figure. By 1929 this inspected slaughter had dropped to below 8.3 million (see Chief of the U.S. Bureau of Animal Industry, *Annual Reports*). It must not, however, be taken for granted that the production of edible tallow and oleostearin is directly proportional to the number of animals slaughtered, for it depends also upon the fatness of the animals. This varies from year to year with the relative prices of feeds and beef. In general, the growing practice of recent years to market animals at a younger age in the form of baby beef and lamb would tend to lower the yield per animal of edible fats. During much of 1926, oleostearin prices were below those for cottonseed oil. This would be expected to stimulate the production of shortening containing oleostearin at the expense of that made entirely of cottonseed oil. Also it is possible that the increased output may have been almost entirely in purely vegetable shortening turned out by meat-packing establishments.

plants, were it not for the fact that the census figures for all packers, whether inspected or not, include a certain amount of compound made for local consumption in meat-packing establishments without federal inspection. This amount is probably small. Moreover, the data of the *Biennial Census of Manufactures* indicate that large quantities of "lard substitutes" (Table XIII), containing some animal fat, are made in establishments engaged principally in the manufacture of lard substitutes. Of this volume of lard substitutes containing animal fat, appreciable quantities are apparently made without federal inspection.

Since, as we have just seen, the contribution of the meat packers to the nation's production of compound has declined actually and relatively since 1925, it is not surprising to note that the relative importance of this commodity in the packing industry itself has likewise dwindled (Table XI). In 1914 and 1919, the value of compound produced by the slaughtering and meat-packing industry amounted to 2.0 per cent and 2.9 per cent, respectively, of the aggregate value of all its products. Since then the percentage has been below 2.0; in 1929 it was only 1.4, but it rose to 1.8 in 1931.

The production of lard by this industry has also lost in relative importance as compared with the high figures of 1919 and 1923, when it averaged nearly 10 per cent of the value of the entire output of the industry (Table XI). In the last three census years, it amounted to 7.7, 7.2, and 6.9 per cent, respectively, of the value of all packing-house products. Lard has been called the "neglected child" of the packers. In recent years, it appears to have been less profitable than formerly, and the packers have begun actively to concern themselves with the problem of re-establishing it on a more advantageous footing (see pp. 207 ff.)

On the basis of the foregoing percentages, showing the portion of total value of packing-house products accounted for by lard on the one hand, and compound on the other, we see that, while both are losing ground with respect to their share of the aggregate output, compound production likewise declined relatively to the output of lard (Table XI). In 1914 and also in 1919, compound was produced with an aggregate value of 27 and 30 per cent respectively of the value of lard produced in the corresponding years. In 1923, when cottonseed oil was scarce and high-priced, the packer output of compound was only 12.4 per cent of the value of both. During the next four biennial census years, however, the former averaged about one-fifth of the latter in slaughtering and meat-packing establishments reported by the census.

Production by Class of Product

It is impossible to state with exactness what portion of the present output is composed solely of hydrogenated vegetable oil, and what portion is made by combining animal and vegetable ingredients. According to the recent report of the United States Tariff Commission,[1] "data obtained by the commission in response to a questionnaire sent out to representative producers in 1924 show that from 54 to 59 per cent of production in the period 1920–1923 was made entirely of vegetable oils. These data cover all types of producers, including those engaged primarily in meat packing." The Census of Manufactures distinguishes the two types only in its reports covering establishments engaged primarily in the manufacture of lard substitutes, and for these establishments only for the last four biennial years, 1925 to 1931. Among this group of producers, the purely vegetable product

[1] *Op. cit.* (1932), 159.

dominates the field. Of the total output of these producers, the percentage made with no animal fats was 63 in 1925, 69 in 1927, 79 in 1929, and 73 in 1931 (Table XVI). Had the production of the packers been included, these percentages would probably have been materially less. Since the data for 1925 do not include in this group the output of those establishments whose chief product is vegetable oil, as they do for the succeeding years, the aggregate product figures for this earlier year are not strictly comparable with those for the two later years. Inasmuch as the lard substitutes produced by establishments engaged primarily in the manufacture of vegetable cooking oils did not constitute a large item in the total production of that group of products, it seems legitimate to compare certain percentage variations between 1925 and the two following years, 1927 and 1929. If, however, the amount of lard substitutes produced by this vegetable cooking-oil group had been included with those of lard-substitute manufacturers as in 1927 and 1929, the percentage of purely vegetable shortening to the total of these combined groups in 1925 would, of course, have appeared slightly greater,[1] and the ratio of increase relative to the total production would have appeared to be correspondingly smaller. The changes which occurred between 1927 and 1929, however, indicate unmistakably a definite trend away from animal fats in the manufacture of shortening by establishments which are engaged primarily in the production of compound. With an aggregate increase in production by these establishments of lard substitutes of 57 million pounds or 7 per cent, that portion containing animal fats actually declined nearly 64 million pounds or 27 per cent, while the output of

[1] The production of shortening by the vegetable cooking-oil manufacturers in 1925 was included in a miscellaneous group where it is made as a secondary product. The aggregate output of this group, however, amounted to only 5 per cent of the total lard-substitute production for that year.

purely vegetable shortening between these two years expanded 121 million pounds or nearly 23 per cent (Table XIII).

The latest census returns likewise made it fairly clear that purely vegetable shortening had gained at the expense of the mixed animal and vegetable product. This is attested by the fact that, both in 1929 and 1931, the output of the former by establishments engaged primarily in producing lard substitutes constituted over half of the entire production of all kinds of compound by all classes of establishments (compare Tables X, XIII). In 1925 the proportion was only 34 per cent, and in 1927 it was 46 per cent.

An examination of the descriptions of compounds registered in recent years in the United States Patent Office (see Appendix D) contributes some evidence on the question of the present relative importance of the several types of shortening on the market. Among the newer trademarked brands, there is a preponderance of those described as purely vegetable. Obviously, nothing is known about their relative volume of output, but their numerical superiority over other types at once suggests that the trade at the present time leans rather toward hydrogenated vegetable-oil shortenings than toward those made of mixed vegetable and animal fats.

Among the packers, on the other hand, the situation is essentially different. Slaughtering and meat-packing establishments undertake the production of compound partly as a means of marketing oleostearin. Producers of edible animal fats suitable for hardening purposes find this their best present outlet. Accordingly, it is natural for packers to continue manufacturing this type of product in such volume as seems advisable in view of available supplies and prices of hard animal fats and cottonseed oil in relation to the current demands of the trade

for the compound into which they are made. The larger packing houses, of course, likewise produce some pure vegetable shortening in order to meet the varied requirements of their customers, but their primary interest has been, and continues to be, in shortening containing animal fats.

It must be recognized in this connection, however, that the volume of production of oleostearin and edible tallow is to a considerable extent independent of the demand for these two fats for compound production in spite of the fact that this industry affords their principal outlet. Oleostearin, as we have seen, remains as a by-product from the production of oleo oil extensively used in margarine manufacture. Edible tallow, made from similar types of fats as oleo stock, but differently rendered, is likewise a packing-house by-product, the supply of which varies, principally with the volume of slaughter of cattle and sheep. Since most of the packers originally undertook the production of compound largely as a means of disposing profitably of their supplies of edible tallow and oleostearin, we may expect the volume of production of this type of compound to depend closely on available stocks of these fats for which few other food uses are open. As long as this obtains, hydrogenation will not completely displace hard animal fats in the compound industry. It is, of course, conceivable that some day the costs of vegetable shortening may so decline as to be less than the direct costs of mixed animal and vegetable compound. However, this contingency seems so remote today as hardly to warrant mention.

There is no complete record of the volume of output of mixed vegetable and animal shortening. As we have seen, considerable quantities of compound containing some animal fat are made outside federal inspection by establishments engaged primarily in the manufacture of

lard substitutes (pp. 138, 140). Probably, none of these concerns is a meat-packing plant, for meat packers would not be classed as engaged primarily in manufacturing compound. Moreover, the figures for production under federal inspection probably understate the total of production in meat-packing plants, because the law does not apply to goods that do not enter interstate or foreign commerce. In large states, such as Texas or California, the production of compound in meat-packing plants for purely intrastate distribution may reach substantial quantities. In California, in 1931, 2.9 million pounds of lard substitute containing animal fats were reported to have been prepared in abattoirs operating under state meat inspection. This figure is probably below the true output, because the state law, since amended, did not require inspection of *all* slaughtering and processing establishments.[1] It is, therefore, obvious that, if similar data for all states were available, the aggregate might be of the order of magnitude of 40 million pounds or more.

The production of compound in meat-packing plants under state and municipal inspection or operating without inspection of any kind, as well as production of compound containing some animal fat in uninspected plants that are not engaged in meat packing, may account, possibly, for the virtual maintenance of the relative importance of the major animal ingredients (see p. 119), despite the irregular decline in the relative volume of production under federal inspection noted in the preceding section. Such production would also help to explain the gain, both absolutely and relatively, in the output of purely vegetable shortening by the major group of producers, while the volume of mixed animal and vegetable shortening produced by this group and by inspected packers is de-

[1] Information kindly furnished by Mr. J. J. King, Chief of the Division of Animal Industry, California State Department of Agriculture.

clining. The packers, undoubtedly, make mainly the latter type of shortening. There has been a movement in the meat-packing industry in recent years toward decentralization in production, and probably a more or less corresponding tendency toward increase in meat production outside federal inspection.[1] To the extent that this has occurred, there may have been a parallel relative decline in compound production subject to federal inspection, even though the actual volume of product containing animal fats was not declining either absolutely or relatively. If so, this would help to account for maintained utilization of animal ingredients in compound in the face of declining production in inspected plants.

It is difficult to say, however, how much weight should be given to these considerations, for, if large quantities of compound were being made in uninspected meat-packing plants, then the census figures for compound production by all meat packers, whether inspected or not, should be much greater than those for inspected plants alone. As we have seen, they are not (Table X). The reason why they are not greater may be, as we have noted above, that the figures for inspected production include purely vegetable shortening made under inspection, partly in meat-packing plants and partly in other establishments. If it were possible to subtract this vegetable-shortening production, the discrepancy between the figures for inspected production and for production by all meat packers might prove to be more apparent than real. In short, though no definite figure for the total production of mixed animal and vegetable compound can be arrived at, the evidence presented in the foregoing pages warrants the conclusion that, for the country as a whole, the trend up to 1930 has been in the direction of decreasing importance

[1] See Zapoleon, *op. cit.*, 20; also C. A. Bender, "Centrifugal Economic Forces in the Meat-Packing Industry," *Food Industries*, November 1932, IV, 365.

of mixed animal and vegetable compound. According to the recent report of the United States Tariff Commission.[1] this trend has been interrupted in 1930 and 1931, for, according to trade reports, mixed animal and vegetable compound has become relatively more important in the present depression than it was before. Combinations are said to be now used containing large proportions of animal fat, for example: (1) tallow, 25–30 per cent; coconut oil, 10 per cent; and the remainder, cottonseed oil; or (2) oleo oil and/or edible tallow, 45 per cent; and the remainder, sesame and/or cottonseed oil with a little coconut oil.[2] The reason for these formulae is, of course, the relatively low price of animal fats as compared with cottonseed oil. This is not noticeably true of oleostearin prices, but may be so of tallow prices, though ordinarily prices of the former do not depart widely from those of the latter.

It has been pointed out above (p. 133) that the Agricultural Adjustment Act may have some interesting repercussions on the shortening industry through its undertaking to control production of cotton and hogs. It would appear probable that one result will be a further encouragement to the utilization of animal fats in compound, thus strengthening the tendency noted in the last two or three years away from the earlier trend toward purely vegetable compounds. Such increased utilization of animal fats can, however, take either or both of two forms, and the manner in which current government data on fats and oils are compiled and presented precludes a determination of the exact facts of the situation. A greater use of animal fats might be the reflection of a change in formula such as the one just quoted, whereby a higher percentage of animal fats is used in specific products, or

[1] *Op. cit.* (1932), 159.

[2] *Ibid.*, 161.

producers of shortenings formerly composed solely of vegetable oils might resort to animal fats. If the first alone occurred, it might still be true that the predominant trend was away from mixed animal and vegetable compounds, in spite of the showing of greater consumption of animal fats in the industry as a whole. The chances are, however, that the price relationships which make it advantageous to increase the animal-fat content of mixed compounds are also conducive to a substitution of some animal fat in a portion of the output hitherto purely vegetable.

Production Costs

The Census of Manufactures contributes some further data on the compound industry in the field of production costs. In 1925, when this industry was reported separately for the first time, the total value of product of establishments included in this classification was divided, according to the usual census practice, into materials costs, wages costs, and total value added by manufacture, of which wages costs constitute a part. In this report, likewise, figures were published for earlier years back to 1914, and subsequent reports have made available returns for 1927, 1929, and 1931.[1]

The most noteworthy fact regarding the elements which go to make up the total value of product in the compound industry is the exceedingly important place occupied by the cost of materials (including containers, fuel,

[1] The analysis of census returns over a period of years is always subject to the limitation imposed by the fact that certain changes in classification of industries and items from time to time destroy the complete comparability of the data. This is true of the compound industry. Such changes as have been noted by the census, however, appear to be minor, for the most part, and the data themselves do not suggest any great modifications in relationships as a result thereof. The most important change occurred in 1927 when vegetable cooking oils for the first time were included in the returns with lard substitutes. Production figures here employed exclude the output of vegetable oils, but the cost figures do not.

and purchased electric current), and the correspondingly small labor cost per dollar of product. For concerns producing primarily lard substitutes for the years 1914–21 and shortenings (exclusive of lard) and vegetable cooking oils for the years 1923–31, the following figures, expressed in cents per dollar of product, are illuminating:

Census year	Cost of materials, etc.	Value added by manufacture	
		Wages	All other
1914	80.6	1.6	17.8
1919	91.4	1.9	6.7
1921	92.8	3.2	4.0
1923	89.1	2.4	8.5
1925	89.7	1.7	8.6
1927	92.3	1.8	5.9
1929	90.0	2.2	7.8
1931	83.0	3.5	11.5

Not only is the unit labor cost small in this industry, but also the percentage of total value of product accounted for by the remaining items which go to make up the value added by manufacture. In the eight years for which such census data are available, there are four in which wages fell below 2 per cent of the total value of product. During the six biennial census years 1919–29, the cost of materials averaged over 90 per cent of the value of product. This means that ordinarily the supply price of the finished product depends largely on the price of the raw material, which in the case of compound is predominantly cottonseed oil. It shows, likewise, the relative simplicity in the processing of this commodity, particularly as regards quantity of labor required.

If one compares certain other food industries with the compound industry in the matter of material and labor costs, on the same basis as shown below, it will be seen that in none is the cost of materials per dollar of output

as high or the cost of wages so low in the three years shown. The butter industry approaches the compound

	Cost of materials			Wages		
	1923	1927	1931	1923	1927	1931
All manufacturing industries	57.3	56.0	51.8	18.2	17.3	17.5
Food and kindred products	73.4	73.7	...	8.4	7.5	...
Oleomargarine	71.7	69.1	66.9	5.3	5.7	5.9
Butter	85.8	86.2	84.8	3.9	3.5	4.0
Slaughtering and meat-packing	84.2	87.1	84.4	6.5	5.3	6.2
Cooking-fat industries	89.1	92.3	86.5	2.4	1.8	3.5

industry most closely as regards the wages item, while the slaughtering and meat-packing industry joins the butter producers in showing the closest correspondence in the percentage of cost of materials to total value of products. In 1923 and 1927 the margarine industry paid more than twice as much in wages per dollar of product as the compound industry. The food industries in general have a considerably higher cost of materials and a much lower cost of wages per dollar of product than do manufacturing industries as a whole.

Ownership Concentration and Geographical Distribution of Production

While monopoly control has never characterized the compound industry, the great bulk of the output has been and is produced by a few large concerns. Figures given in the Federal Trade Commission's 1919 report on the meat-packing industry (pp. 223–24) illustrate this point. For 1916, an output representing about 80 per cent of the Department of Agriculture's estimate of total production (Table X) was reported distributed as follows:

Class of producers	Million pounds		Percentage of total	
Cottonseed-oil manufacturers..		418.8		49.9
"Big Five" packers[a]				
Swift	143.8		17.1	
Armour[b]	99.7		11.9	
Morris	44.1		5.3	
Wilson	39.6		4.7	
Cudahy	29.2	356.4	3.5	42.5
Other interstate slaughterers		64.2		7.6
Total		839.4		100.0

[a] Including production in their cottonseed-oil plants.

[b] Except for two plants, data are for years ending October 28, 1916.

The same report gave the following percentages (p. 216) of the total output of refined cottonseed oil in the season 1916–17:[1]

	Percentage		Percentage
Five largest refiners	*52.2*	"Big Five" packers	*31.8*
Procter and Gamble	16.3	Swift	10.3
Southern Cotton Oil Company	15.3	Armour	8.1
American Cotton Oil Company	11.0	Wilson	7.1
Magnolia Provision Company	6.3	Morris	4.2
Portsmouth Cotton Oil Refining Corporation	3.3	Cudahy	2.1
All other producers			16.0

No recent data of similar character are available.[2] It is reasonably clear, however, that, while the distribution of production has changed, control of production is still heavily concentrated in a few large concerns.

Published census data do not permit one to determine the total number of separate establishments that manu-

[1] Recent information indicates still greater concentration. Three of the large cottonseed-oil refiners (Procter and Gamble Company, through its subsidiary, the Buckeye Cotton Oil Company; Wesson Oil and Snowdrift Company, through its subsidiary, the Southern Cotton Oil Company; and Swift and Company, under its own name and through its subsidiary, the Consumers Cotton Oil Company) use about 60 per cent of the crude cottonseed-oil output (*Senate Document*, 209, Part 13, p. ix [71st Congress, Second Session, Serial No. 9216, May 1933]).

[2] See also testimony before the Supreme Court of the District of Columbia in Equity No. 37623, on Petitions of Swift and Company and Armour and Company, etc., for modification of (Packers' Consent) Decree of February 27, 1920.

facture compound, or how they are grouped by ownership. Establishments engaged primarily in manufacturing shortenings (other than lard) and vegetable cooking oils, however, numbered 33 in 1927, 40 in 1929, and 49 in 1931.[1] Compound is also produced, however, in a considerable number of plants engaged primarily in slaughtering and meat-packing, and in some others.

In the early years, as we have seen, the production of compound was largely concentrated in Chicago, where the larger packers and lard refiners had their headquarters. In the late 'eighties, two Chicago concerns, the N. K. Fairbank Company and Armour and Company, were said to have accounted for nearly 90 per cent of the aggregate output of lard compound at that time. Few of the early establishments were located at points where the seed was crushed or the oil refined. During the 'nineties, the industry expanded in other parts of the country, on the Atlantic seaboard, in the South, and toward the West. By the beginning of the new century, however, there was in evidence a definite drift southward, and today the South leads all other regions in the production of shortening other than lard.

Statistical evidence on the geographical distribution of compound production is limited to figures published in the biennial censuses of manufactures beginning with 1925 (not yet available for 1931) "for each state which can be shown separately without disclosing data for individual establishments." Because of groupings thus made necessary, the comparative summary given opposite fails to give the full picture.[2]

Texas clearly occupies first place among the states in

[1] Fifteenth Census, *Manufactures: 1929*, II, 202; Bureau of the Census, press release of November 4, 1932, giving preliminary 1931 figures on the industry (including salad oils).

[2] *Biennial Census of Manufactures, 1925*, p. 158; *ibid., 1927*, p. 151; Fifteenth Census, *Manufactures: 1929*, II, 203.

the production of compound, having accounted for 19 per cent in 1927, and 17 per cent in 1929. Another Southern state, Tennessee, ranked second in 1927 and 1929 with over 12 per cent of the total in both years. Illinois, which was second in 1925, occupied third place in 1927 and 1929, accounting for about one-tenth of the compound output of the country in those years. Georgia produced about 8 per cent of the aggregate output in both 1925 and 1927, and occupied fourth place among the states in both years; and Louisiana ranked not much lower. In 1929, the output of these two states was not reported separately. Details given for 1925 and 1927, not here presented, make it appear that Ohio and Kentucky combined have an output something like that of Illinois or Tennessee, that Virginia and North Carolina combined have an output something like that of Louisiana, that New York ranks with or above New Jersey, that Oklahoma ranks not far below Kansas, and that Maryland is probably the only other state with much over 1 per cent of the total output.

State	Production (million pounds) 1925	1927	1929	Percentage of total 1925	1927	1929
Texas	201.6	232.9	212.6	17.9	18.8	16.9
Tennessee	113.9	153.8	157.0	10.1	12.4	12.5
Illinois	138.6	123.8	134.2	12.3	10.0	10.7
Georgia	90.7	97.7	....[a]	8.0	7.9	....[a]
Louisiana	76.8	77.4[b]	....[a]	6.8	6.2[b]	....[a]
New Jersey	55.7	70.3	63.6	4.9	5.7	5.1
California	34.1	34.6	42.2	3.0	2.8	3.4
Kansas	37.9	40.2	34.4	3.4	3.2	2.7
All other	380.1	408.4	612.8	33.6	33.0	48.7
Total	1,129.4	1,239.1	1,256.8	100.0	100.0	100.0

[a] Included with all other.

[b] Data for 1927 include Alabama and Florida, but the production in these states is small.

There is no doubt that ordinarily the Southern states produce well over 50 per cent of the total output of com-

pound, and that the percentage is still higher in the cotton states as a whole, including California. Texas, Tennessee, Georgia, and Louisiana lead among Southern states in this order. A very substantial fraction is, however, produced in the Northern states, especially in Illinois, Ohio, and Kansas, west of the Alleghenies, and in New York, New Jersey, and Maryland on the Atlantic seaboard. There is some production in many other states.

The shift of the industry to the South is in large part a reflection of the fact already noted that producers of cottonseed oil undertook more and more to market the output of their mills in the form of compound. This tendency toward vertical integration caused compound factories to be located near crushing mills and refineries where supervision could be centralized, and continuous processing achieved. Certain large Northern corporations have likewise extended compound production in the South by the acquisition of local concerns which, in some cases, were experiencing financial difficulties. These corporations have, at the same time, maintained production in their Northern and Eastern plants, which are situated close to great consuming areas. Many Southern plants are not far from the coast, and are advantageously located for exports to Cuba and other Latin-American countries, and for coastwise water shipments to densely populated consuming centers along the seaboard. Thus, with the increase in relative importance of cottonseed-oil producers in the industry, and the parallel decline in relative importance of the meat packers, it is natural to find the South leading in the production of this shortening.[1]

Future census returns will doubtless reveal a growing

[1] The advantages of abundant and relatively cheap labor which have attracted some industries southward probably have little influence on the location of compound plants, since the labor cost in this commodity has averaged about 2.3 per cent of the value of the product (see page 147).

compound industry on the Pacific Coast. This is to be expected, not only on the basis of its rapidly increasing population, but also because of its favorable location with respect to certain oils and fats. The population of California has registered an enormous growth in the last ten years. This state alone offers a market of approximately six million people. Its output of compound in 1929 was above 42 million pounds, or 3.4 per cent of the total. If cottonseed oil continues to be the principal ingredient of the shortening, the southern portion of the state is not disadvantageously located with respect to supplies from western Texas, Arizona, Mexico, and its own small but expanding cotton-producing area. In the crop year ended July 31, 1930, California produced nearly 37.5 million pounds of crude cottonseed oil, or about 2.4 per cent of the national output. The entire Pacific Coast is well situated with respect to fish oils and to vegetable oils from the Orient. Ultimately these oils may assume considerably more importance in the industry than immediate prospects would indicate. If they do, the expansion of the industry on the Pacific Coast will be materially stimulated.[1]

Present Export Trade in Compound

As we have already seen, exports of compound have declined to very small proportions in recent years (Table V, and Chart 10, p. 109). At their pre-war peak, from 1905–06 to 1912–13, they averaged 72 million pounds a year and in 1906–07 exceeded 80 million. The record was reached in 1919, 125 million pounds, when Europe imported heavily after the war-imposed shortage of fats. The average for 1923–27 was only 17.3 million pounds, and in 1928–32 only 7.7 million; exports in 1933 were only 2.6 million. While the latest figures are doubtless lower because of

[1] There are already a number of plants producing compound on the Pacific Coast, including several branch plants of large Eastern producers.

the unfavorable international situation, exports were very small before the onset of the current depression.

Shipments to United States possessions (Table VII), apart from the Philippines, have never much exceeded 10 million pounds, and in no year since 1922 have they reached 5 million. In recent years, shipments to Puerto Rico (like exports to Cuba) have declined as lard shipments have increased. Hawaii, however, has proved an expanding market. In 1932, indeed, shipments to Hawaii alone slightly exceeded exports to all foreign countries.

Including shipments to Hawaii, Puerto Rico, and Alaska with exports to the Philippines and foreign countries, the total in 1933 was only 7 million pounds, certainly the smallest since 1896–97. Probably at its maximum, exports did not constitute more than 10 per cent of the output; but now that exports and shipments to possessions combined are less than 1 or 2 per cent of the output, external trade is hardly an appreciable factor in the industry.

One reason for the sharp decline in exports of compound after 1922 was doubtless the disruption of the foreign sales organizations of both the American Cotton Oil Company and the Southern Cotton Oil Company, which were involved in financial difficulties in 1922 and 1923. These two concerns had been highly important factors in the foreign field as sellers of cottonseed oil and cottonseed-oil products, and the disintegration of the American Cotton Oil Company and the reorganization of the Southern Cotton Oil Company were accompanied by an almost complete breakdown of their foreign sales connections. Some have attributed this breakdown in part to changes in tariff rates.[1]

Another factor, however, is of major importance. In

[1] Cf. P. G. Wright, *The Tariff on Animal and Vegetable Oils* (New York, Macmillan, 1928), 122–25.

recent years, lard exports have expanded greatly to Cuba, Puerto Rico, and other markets where compound had gained a strong hold (Tables VI *B*–VII). Whereas up to 1923 the average export price of lard was almost invariably considerably higher than that of compound, in all but three years (1925–27) since 1923 the opposite relationship has held (Chart 10, p. 109). With recovery of swine husbandry in Europe since the war, and further growth of the war-expanded vegetable oils industry there, our lard surplus has been exported with increasing difficulty. Pressure from lard competition must be accounted an important element in the shrinkage of compound exports. Producers of compound have evidently felt unable or unwilling to meet this competition, and only in Hawaii have they increased their sales while lard exporters have not.

Beginning with 1922, exports of compound containing animal fats and of compound composed wholly of vegetable ingredients have been reported separately (Table XVI). During these years, except for the period 1924 to 1927 inclusive, exports of the latter type have exceeded those of the former. Omitting 1922, however, practically as much of one has been sent abroad as of the other. It is worth noting that figures for recent years seem to indicate a definite preference for the purely vegetable shortening among foreign consumers of the American product.

Some recovery from the present extremely low level of compound exports is not unlikely to come, as the world emerges from depression and in years when lard export competition is less severe and when cottonseed oil is abundant and cheap. Yet for various reasons there is no present prospect that the export trade in compound will increase to major proportions, or even to those which it had before the war.

Germany has evidently shifted to a much heavier mar-

garine consumption than before the war, as has Great Britain to a less pronounced extent.[1] International organization of the European margarine industry[2] may so strengthen the position of this product, already generally preferred there as a cooking fat to compound, that the American compound industry may never regain even its former modest position in European markets. Indeed, there is no valid reason why Europe should take American compound so long as it is able to secure the raw materials at about the same prices as American manufacturers. Under such circumstances, Europe has every incentive to manufacture such volume of cooking fat as it may require. It has a further incentive in its need for concentrated feeding stuffs, like oil cake. It has every reason to import oilseeds, crush them, utilize the cake for feed, and manufacture margarine, cooking fat, salad oil, etc., from the oil. Under normal price relationships, this is more in its interests than to purchase finished products and lose domestic production of valuable essential feeding stuffs. Moreover, countries with colonial dependencies like Great Britain, France, Holland, and Belgium find it advantageous to import colonial oilseeds and vegetable oils as a means of developing their backward colonies and dependencies.

Up to the present, the continent of Europe has not developed an extensive compound industry, presumably because cheap types of margarine are available, and also because of a preference for lard, which is satisfied in part by domestic lard and in part by imported lard furnished to a large extent by the United States. As the history of the compound industry in this country amply demonstrates, such a preference is not an insuperable obstacle to the gradual development of a demand for compound.

[1] See Snodgrass, *op. cit.* (1930), chap. xvi.

[2] *Ibid.*, chap. xvii.

Europe is uniformly following the policy of encouraging its animal husbandry in order to become as nearly self-sufficient as circumstances will permit. It has every incentive to discourage imports of lard from the United States if this can be done without raising unduly the cost of living. To put in force tariffs on lard in order to encourage swine husbandry as well as the consumption of compound would be consistent with such a policy. Lard tariffs in lard-importing countries would tend to raise lard prices, to stimulate swine husbandry, and to encourage substitution of domestic compound for imported lard. Increasing demand for lard substitutes would enlarge the production of these foods from imported raw materials. With tariffs on oils, but oilseeds free, the oilseed-crushing industry might be expected to expand and furnish more by-product oil cake, a valuable concentrated feed, the availability of which would tend to stimulate animal husbandry in general. It is, therefore, well within the range of possibilities that certain countries of Europe within the next decade or two may enlarge compound production.

Indeed, signs of increasing activity in compound, especially in Germany, are not lacking. In Germany, compound is known as *Kunstspeisefett* (artificial food fat), but this term has a wider meaning than the word compound. There are no separate statistics for the consumption of *Kunstspeisefett*. In 1932 it is estimated the consumption was 24,000 tons manufactured almost exclusively from coconut oil and palm kernel oil.[1] In the following tabulation[2] of fats consumed in Germany (in thousand metric tons) it is presumably included in next to the last group.

[1] K. Brandt, "Die neue Lage am Deutschen Speisefettmarkt," *Blätter für Landwirtschaftliche Marktforschung,* April 1933, III, Heft 11, p. 469.

[2] From *Reichsforschungstelle für landwirtschaftliches Marktwesen* (Berlin).

Fats	Thousand metric tons consumed 1927	1928	1929	1930
Margarine	418	440	470	501
Butter	394	452	484	442
Lard	208	205	203	201
Vegetable oil and fats	183	232	243	242
Tallow	12	10	10	8

This tabulation is significant in that it indicates a slightly decreasing consumption of lard and edible tallow (including stearin). Lard, tallow, and stearin comprise 95 per cent of all German animal-fat imports. The amounts of these fats imported during 1931 were not appreciably less than in 1930, but show a steady reduction during the past five years and amounted to only 59 per cent of the animal fats imported in 1913.[1] The decline of importations is to be interpreted as indicating increasing domestic production of animal fats and increasing use of imported oil seeds and vegetable oils. This interpretation is supported by the evidence, in the foregoing tabulation, of increasing consumption of butter, an animal product, or margarine, a vegetable product predominantly, and of vegetable oils and fats in the order named.[2] The last category increased 21.3 per cent in four years, and a part of this increase may well have been *Kunstspeisefett*. This food fat is about 20 per cent dearer than cheap margarine, but slightly below the price of best-quality margarine. However, margarine in Europe contains from 15 to 20 per cent of water, so that, based on food value, the two fats are on a par. *Kunstspeisefett* is sold not only to bakers and confectioners, but also in retail packages for household use. Restaurants are also important users of this product. On the whole, these German statistics hold no promise of a larger market for the American compounder. Moreover, in March 1933, regulations were put

[1] U.S. Department of Commerce, *Foodstuffs 'Round the World: Foreign Notes on Meats, Fats, Oils, and Livestock*, April 8, 1932.
[2] Cf. Brandt, *op. cit.*, p. 478.

in force to encourage the use of domestic animal fats;[1] and tariff rates on lard were raised on February 15, May 16, and July 19 successively from 10 to 50, 75, and 100 reichmarks per quintal.[2] These measures are bound to affect German fat consumption profoundly.

It is obvious, therefore, that, even in the long view, there seems little prospect that compounders will find an enlarged market in Europe.

Exports to South America, never considerable, have dwindled, for some countries to the vanishing point. This is partly because some of these republics have been developing swine husbandry, partly because of the imposition of heavy duties, as by Colombia. Other countries, like Argentina and Uruguay, have a surplus of animal fats. It is not strange, therefore, that in Argentina and Uruguay beef tallow is the principal cooking fat, though olive oil is preferred as elsewhere by the Italian and Spanish elements. In other countries, lard is the preferred cooking fat, but in some regions tallow is also used by the poorer classes. In Chile, a compound of beef and other fats and cottonseed oil, known as *grasa,* is used by the low-income groups. It is produced domestically and some was imported before the war, predominantly from Uruguay. All things considered, in the face of the growing animal husbandry of South America, there seems little prospect of enlarging exports there.[3]

The Tariff and Compound

In the matter of both lard and compound, there can be little or no question that tariff duties on these fats[4] in

[1] *Ibid.,* where the regulations are reprinted in full.

[2] *Monatliche Nachweise über den auswärtigen Handel Deutschlands,* January 1933, p. 36; U.S. Department of Agriculture, *World Hog and Pork Prospects,* June 16, 1933, p. 6; *ibid.,* August 25, 1933, p. 18.

[3] Cf. *Cooking Fats in South America* (U.S. Department of Commerce, Special Consular Reports, No. 67, 1915).

[4] For tariff rates on lard, lard substitutes, cottonseed oil, and several other fats and oils directly or indirectly related to the compound industry, see Table XIX.

the United States are of no real consequence. Of the former, we are the largest producers and exporters in the world. The level of lard exports was greater in the decade 1920–29 than ever before. Of compound, the United States is by far the largest producer; and though our exports are small, our imports are, and always have been, insignificant or nil, so that in recent years they have not even been reported separately. The lack of any appreciable imports of compound has not been due to tariff barriers, for comparatively little compound is produced in other countries. Besides, it was not until 1922 that such a tariff was imposed. Any effect of a tariff upon compound can, therefore, be exerted only through tariffs on lard and other fats and oils.

Since 1883, except for the period 1913–22, there has been a tariff on lard ranging from 1 to 3 cents a pound. If such a tariff had raised the price level of lard, its principal competitor, compound, might have profited. There are, however, no signs that the lard tariffs have had any such effects. The fact that in exceptional cases, for example wheat, tariffs have had an influence upon agricultural commodities of which there is an exportable surplus proves nothing as regards lard, for the position of lard is quite different from that of wheat.

Wheat is not a homogeneous commodity; it is really a group of commodities which are not readily substituted for one another without complaint from ultimate consumers. Soft wheats cannot satisfactorily be substituted for hard ones; and in some years there is a deficiency of good hard wheat. In these years, the tariff may have an effect upon hard-wheat prices. Furthermore, there are years of short or poor-quality wheat crops in which the supply of good-quality wheat of most sorts is short and, in those years, the wheat tariff, despite a certain limited volume of exports, may exert more or less effect upon

the general level of wheat prices in the United States. Upon lard prices, tariffs can have no clean-cut effect. There is never a year in which a large part of the production is not exported. Moreover, while the trade recognizes different grades and qualities, lard is a far more homogeneous commodity than wheat, so that the possibility of substitution as between different grades is much greater. For wheat, there is no satisfactory substitute; for lard, there are compound, margarine, and other fats, which are substituted in practice under suitable price incentives. Finally, in wheat, the United States has long ceased to be a major factor in world trade; whereas the United States exports a very large fraction of the lard entering into international trade. In consequence, American lard unquestionably plays a larger rôle in influencing world prices for lard than does American wheat in influencing world wheat prices.

While the case is clear in regard to tariffs on lard and on compound, the situation with regard to vegetable-oil tariffs is more complicated. Since the depression of 1921–22, there has been much agitation for tariffs to protect American fat-and-oil producers against the competition of imported oils, especially tropical vegetable oils. The principal proponents of such tariffs, however, have not been the hog raisers, but rather the dairy interests and the producers of vegetable oils, notably the peanut growers, the growers of flaxseed, and to some extent the producers of cottonseed oil. The principal opponents have been such industrial users as paint, varnish, soap, and margarine manufacturers. To producers of fats and oils, it has been represented that tariffs on fats and oils must have the effect of raising the general price level of all fats and oils, because these are, for the most part, more or less interchangeable. The possibility of such an effect of tariffs must in theory be granted, for, since 1925, the

United States has been a net importer of oleaginous material.[1] The United States is an importer of some oils (notably, coconut, palm, peanut, and drying oils), produces about enough cottonseed oil for its own needs, is to a small extent a net importer of inedible tallow, and is a heavy exporter of lard, edible tallow, and oleo oil. Even if we exclude butter while including lard, the United States still has a surplus of edible fats, taken as a whole, but imports large enough quantities of vegetable oils predominantly for use in such industries as soap-making to overbalance this surplus. Therefore, in order to achieve a notable increase in the *general* price level of fats and oils, there would have to be imposed on each of the fats and oils being imported, or that might be imported, a tariff sufficiently high to restrict importations greatly and force domestic oils and fats into the uses to which the imported oils are customarily put.[2] Since the American surplus consists predominantly of food fats and oils, it would be necessary in some manner to use relatively high-priced edible fats like oleo oil, neutral lard, lard, and cottonseed oil for non-food uses in place of the cheaper vegetable fats now being so used. It must be questioned whether to force into a low-grade use an article that may be put to a high-grade one is in the national interest, however profitable it may be to individuals. It is like using corn instead of coal for fuel, a practice which everyone deplores—even those who may find themselves

[1] Total imports (animal and vegetable, including oil equivalent of seeds and nuts) were 981,396, 925,491, and 671,520 short tons in 1930, 1931, and 1932 respectively; exports were 464,219, 434,645, and 448,573 short tons in 1930, 1931, and 1932 respectively (*Foreign Crops and Markets*, September 25 and October 2, 1933, XXVII, 327, 357).

[2] *The Tariff on Oils and Fats. Brief of Charles W. Holman and Associates Representing Allied Agricultural Organizations and Independent Crushers of Oil Materials. Before the Committee on Ways and Means of the United States House of Representatives in Regard to Changes of Rates of Duties on Vegetable, Animal and Fish Oils, Fats and Greases, and the Raw Materials from which any of them are derived, now included in Paragraphs 53, 54, 55, 57, 58, 701, 703, 760, 1626, 1630, 1632, and 1691 of the Tariff Act of 1922.*

compelled to burn corn—and which no one would think of encouraging by any sort of statutory enactment.

Granted that the raising of the general price level of fats and oils by tariffs is conceivable, it seems important to examine whether the possible increase would be large or small. Even with tariffs as high and as universal as would be necessary, the rise in price level is unlikely to be anything like as great as the duties. Even though lard consumption be increased, the surplus is so great that a certain volume would probably have to continue to be exported and this would have a depressing effect upon domestic prices. The maximum upper limits to which, hypothetically, prices might conceivably rise would, therefore, be set by the world price of lard; but this level is quite unlikely to be approached, for domestic production might be stimulated and consumption, because of high prices, might sink. The ultimate upshot might well be the neutralization of some of the effects of the tariffs to an extent quite impossible to forecast. Moreover, some importation would probably continue, since for certain oils (e.g., Chinese wood [tung] oil)[1] substitution is extremely difficult, and for others costly. Any export of domestically produced surplus that might be necessary would encounter greater competition. If the United States ceased to be a large importer, world prices would sink, because the world supply of oils outside the United States would be enlarged relatively. The American producer would get a lower price for that fraction of his output which went abroad, and this in turn would tend to depress prices within the United States.

It has been claimed that something of this sort has already taken place. There has developed a strong body of opinion to the effect that the duty imposed on certain imported vegetable oils (largely to protect domestic cot-

[1] Florida and Georgia have begun production of tung oil on a small scale.

tonseed and peanut oils) has depressed the price of cottonseed oil in the United States by virtually eliminating American cottonseed oil from its former European market. It was alleged that the tariff shut out Oriental oils from entry into this country and thus gave Europe full control of the Oriental oils on her own terms, with the inevitable result that American cottonseed oil could no longer be sold abroad at a profit.[1] As a matter of fact, cottonseed-oil exports did decline greatly after 1921, and have never since even approached the quantity previously sent abroad, although the volume of seed crushed in recent years shows a full recovery from the low years, 1922–24, and has been as great as, or greater than, ever before. The full explanation of this decline in cottonseed-oil exports without doubt requires consideration of other factors beside the tariff. It must be remembered, of course, that lard production in the years 1922 and 1924 was at a record high level; this, in itself, kept cottonseed-oil prices from rising in full accordance with the greatly curtailed output of these years, resulting from short cotton crops. At any rate, to whatever extent the tariff has cut off foreign outlets for cottonseed oil and created a surplus on the domestic market, it has probably tended to widen the spread that otherwise would have obtained between lard and cottonseed-oil prices, and to that extent has stimulated the compound industry. Such an effect is impossible to prove or disprove statistically, because of the large number of other shifting factors in the situation. In any case, the influence of the tariff on fats and oils, favorable or unfavorable to the compound industry, must of necessity be too small under present circumstances to warrant elaborate analysis.

While it is difficult to see how any considerable gen-

[1] For a full exposition of this view, see issues of the *Cotton Oil Press* during November and December 1921, and Wright, *op. cit.*, 121–24.

eral rise in price level of fats, including lard and compound, can be brought about by any tariffs likely to receive consideration, it is possible that a tariff on a specific oil may affect its American price and, in consequence, its use in compound. As already pointed out (p. 125), peanut oil and soy bean oil were formerly employed for compound. High tariffs imposed on these oils, beginning with 1921 (Table XIX), have raised peanut- and soy-bean-oil prices,[1] and probably were factors in eliminating them from compound. However, in the last few years, prices of all oils, including cottonseed oil, have been quite low, and this alone would tend to discourage the use of foreign oils.

An important shift that might occur as the result of tariffs is the wider use of animal fats in compound. In 1929, the United States exported 87 million pounds of oleo oil and neutral lard, while net imports of vegetable oils (excluding edible olive oil) amounted to 287 million pounds[2] (principally coconut oil). The shutting off of the supply of foreign vegetable oil would probably result in reducing the export of oleo oil and neutral lard, most of which might be available for compound. One result might, therefore, be to strengthen the position of the meat packers in the margarine and compound industries.

On crude and refined coconut oil, the Emergency Tariff Act of 1921 imposed a heavy duty, and the duty since 1922 has been 2 cents a pound. Copra has always been duty-free, and large quantities are imported from the Philippine Islands and elsewhere. The duty upon coconut oil is effective only in that it stimulates production in the Philippines. Large quantities are imported into continental United States from these islands duty-free. The

[1] See Wright, *op. cit.*, 233.

[2] U.S. Tariff Commission, *op. cit.* (1932), 12, and *Foreign Commerce and Navigation of the United States.*

dairy interests have endeavored to have a tariff placed on Philippine coconut oil, or to have the tonnage of oil permitted entry restricted,[1] or, in co-operation with the sugar interests, to have independence conferred on the Islands, whereupon the existing tariff upon foreign oils would go into effect automatically. Were a tariff against Philippine coconut oil to become operative, whether by specific enactment or through the granting of independence, it would be effective only in part, since copra, which is now free, would be imported in increasing amounts, unless a compensatory tariff or specific import restrictions on copra were also enacted. However, because the coconut-oil tariff question is complicated by the Philippine independence issue, the prospects of a tariff on Philippine coconut oil are doubtful at this date of writing.

In short, it is hard to see how tariffs can prove advantageous to the compound industry as a whole. This is because, as above pointed out, lard and cottonseed oil, strongly competitive products, are the principal domestic food fats (excepting butter) and are used almost exclusively for edible purposes. In 1929, if butter and butter fat be disregarded, they formed together about 90 per cent of all domestic fat used for food. It follows, then, that, so long as there remains a large surplus of lard which must be sold abroad, the compound industry can derive little if any benefit from tariffs. Obviously, compound would then be more expensive to produce and its competitive position with reference to lard would be weakened correspondingly, for the price level of lard could not be raised by tariffs. Indeed, its price level might sink, since it would have to meet on the markets of the world the competition of that fraction of the world's fat and oil production which the United States had consumed

[1] The tonnage of Philippine sugar that was permitted entry into the United States was at one time restricted.

before the erection of the hypothetical tariff barriers here under discussion. The situation, as in most tariff questions, is so complex that it is impossible to foretell what the final equilibrium would be; but certainly there is no reason to believe it would be favorable to the compounder. Whether such tariff barriers might, nevertheless, be in the national interest is a different question, which we consider in a following chapter.

CHAPTER V

INTERRELATIONSHIPS OF PRODUCTION, CONSUMPTION, AND PRICES

Factors in Production Variation

In searching for the causes that are responsible for year-to-year variations in the production of compound, two groups of factors must be examined: those relating particularly to the raw materials of the industry, predominantly cottonseed oil; and those relating particularly to its principal competing product, lard. That the lard market exercised a dominating influence in the earlier years of the industry has been made clear. It remains to be determined in what ways and to what extent this interdependence still exists. Such an analysis can be made only for the years 1922–32, for the aggregate output of all classes of establishments did not appear annually and in terms of volume until 1922.

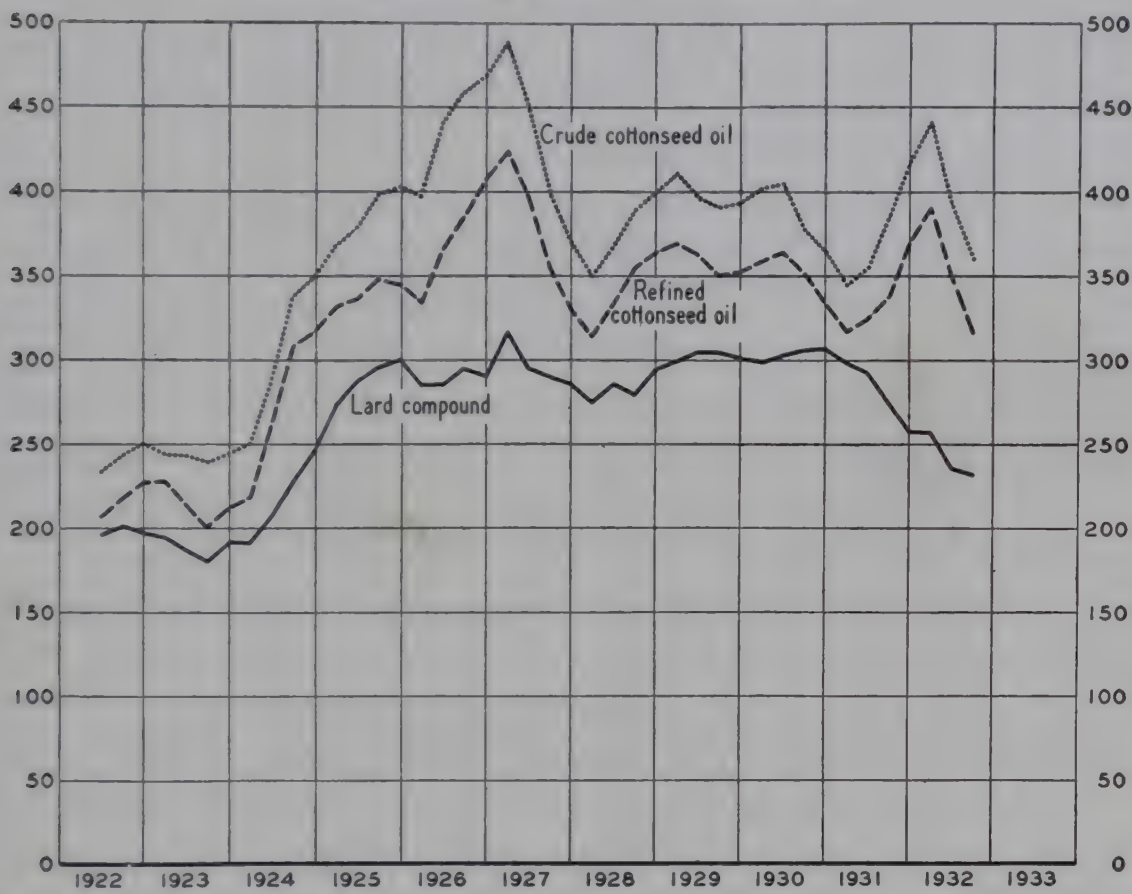
The close relationship between the production of compound and that of cottonseed oil is indicated by Chart 13. Since production of the oil characteristically varies greatly in different quarters of each season, and seasonal variations in production of compound are less pronounced, four-quarter moving averages of the quarterly data are plotted. The approach to parallelism of the curves is apparent, and coefficients of correlation confirm the observed tendency to concurrent variation.

It is obvious that, since the compound industry depends so heavily upon cottonseed oil as a raw material, the maximum volume of compound is largely limited by the available supplies of cottonseed oil. During the first

three years of the decade here under review, cottonseed-oil production was exceptionally low. Chiefly because of short crops of cotton, the output of crude oil was less than a billion pounds in 1921–22 and 1923–24, and only slightly

CHART 13.—COURSE OF PRODUCTION OF COTTONSEED OIL AND COMPOUND, 1922–31*

(Million pounds; 4-quarter moving average)



* Based on quarterly data in Table VIII.

over a billion in 1922–23 (Table I). During these three years the annual average production was about 20 per cent less than for any other year since 1909–10, and nearly 30 per cent below the average for the eleven years ending July 1921. The exceptionally low volume of compound in 1922–24 (see also Chart 9, p. 107) was undoubtedly due in large measure to the limited supplies of its chief raw material.

When, in 1924–25, cottonseed-oil production rose to a much higher level, compound production expanded also. However, compound production failed to expand in corresponding degree, and it appears that one must look to other factors for the explanation of the limited expansion of compound output after 1924. When the huge cotton crop of 1926 was followed by a record output of oil, compound production reached a record peak in the four quarters ending September 1927, but this was not far above the peaks of 1925–26, 1929, and 1930–31 when oil production was much smaller.

It must not be overlooked, however, that the amount of cottonseed oil produced depends in some measure upon the demand for the oil, for compound production, other domestic uses, and export. In several years of the decade, had larger remunerative outlets been available, the percentage of cottonseed crushed and the oil produced might have been higher than it was. This fact presumably accounts in large measure for the low percentage crushed in 1931–32 and to some extent also in 1922–23 and 1923–24.

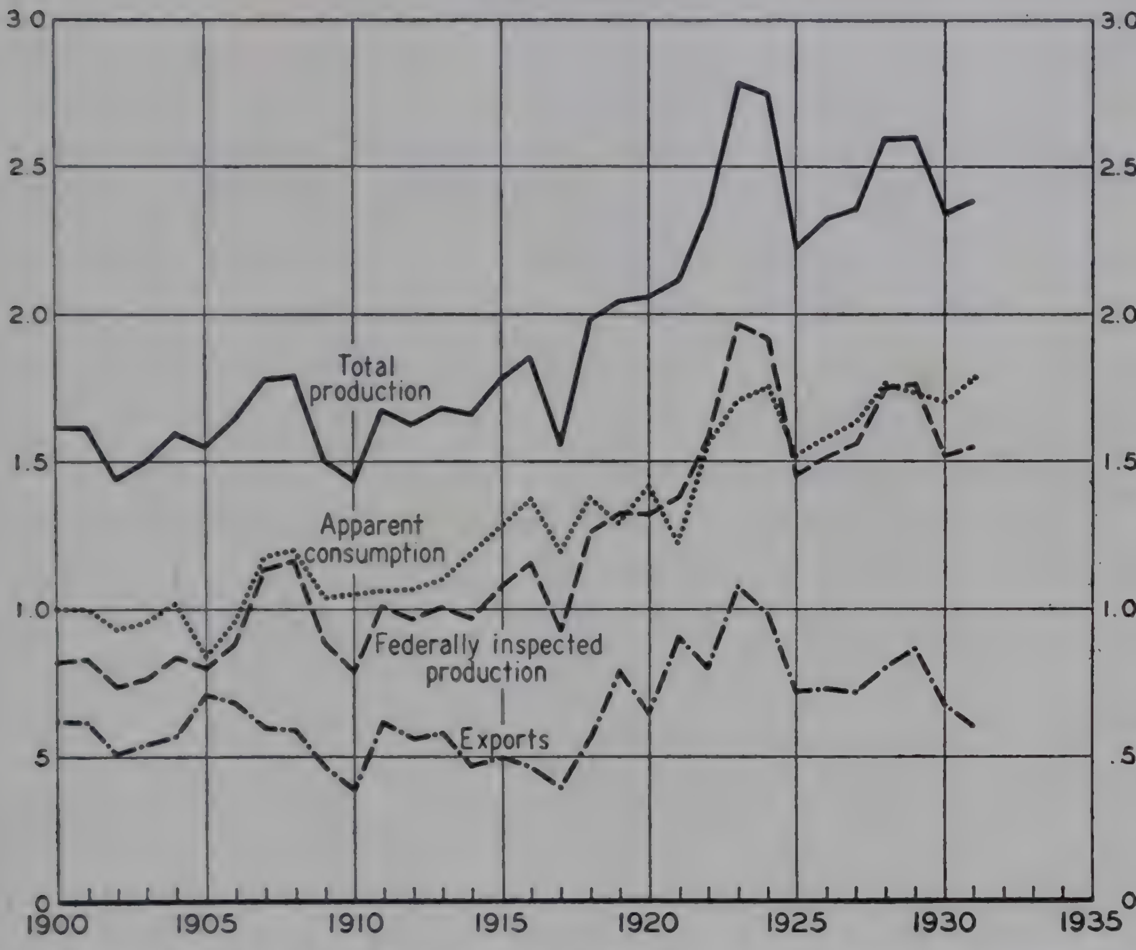
Conditions in the lard market during 1922 to 1924 were also adverse to compound production at that time. As a matter of fact, the production of lard during these three years was greater than ever before in the history of the industry, and the output of 1923 and 1924 has not since been attained (Chart 14). Though exports also reached record heights in 1923 and 1924, unprecedented volumes remained for the domestic market, and apparent per capita consumption was exceptionally high (Chart 19, p. 186).

Considering the abundant supplies of lard, it is noteworthy that lard prices were as firm as they were (Chart 11, p. 113). From the war-time peaks they had fallen below 10 cents a pound in 1921, but through most of the

next three years they fluctuated between 11 and 12½ cents. They were still higher for a time around the end of 1923, and began a sustained advance after the middle of 1925. Undoubtedly the firmness of lard prices was

CHART 14.—LARD PRODUCTION, EXPORTS, AND DOMESTIC RETENTION, 1900–32*

(*Million pounds*)

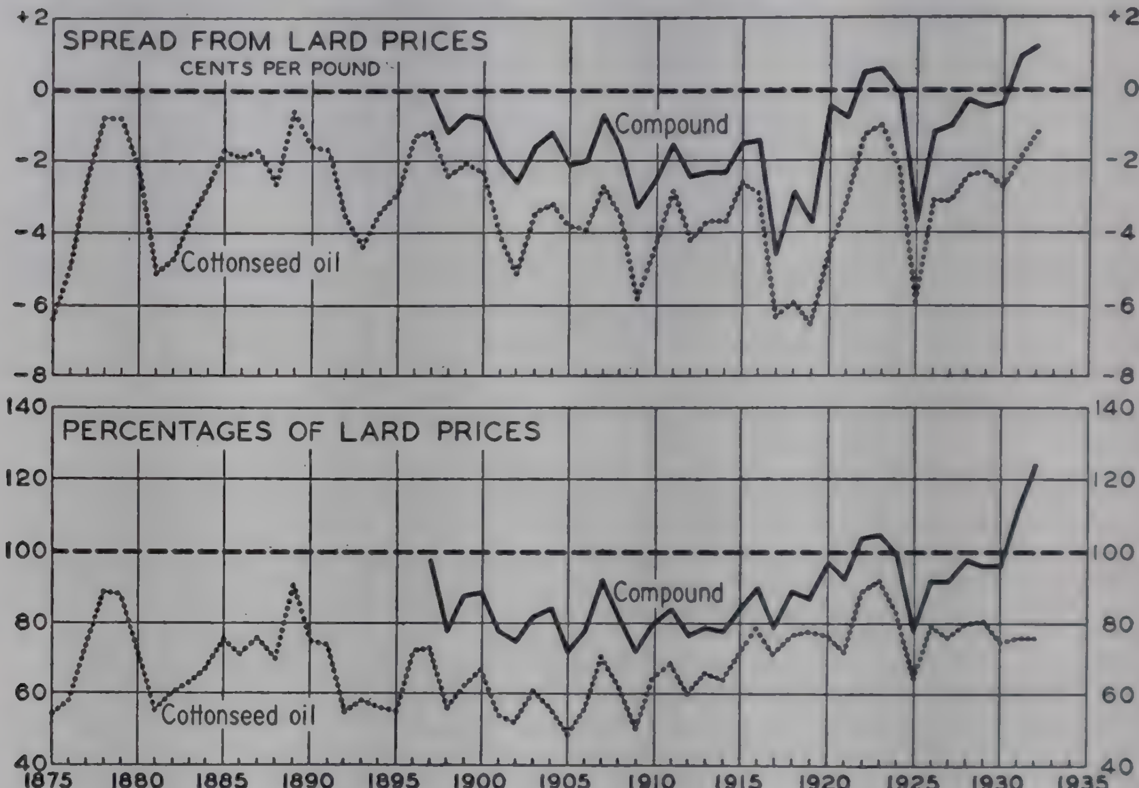


* Data in Table IX. Production data include official estimates, necessarily rough, of the production outside federal inspection. Revision of the estimates, now in progress, may possibly alter the picture appreciably.

aided by general economic recovery and price advances; but a large factor was the shortage of cottonseed oil and the consequent restricted competition from compound. Cottonseed-oil prices were notably strong, and for a short time in 1922 and 1923 were higher than lard prices on the New York market. Compound, which had usually sold

for 1 to 3 cents less than lard, commanded better prices than lard through most of the years 1922–24. This unusual position, which may be observed in Chart 11 (see p. 113), is shown in longer perspective in Chart 15. In the

CHART 15.—SPREADS OF COMPOUND AND COTTONSEED OIL PRICES FROM LARD PRICES, AND PRICES OF COMPOUND AND COTTONSEED OIL AS PERCENTAGES OF LARD PRICES, BASED ON ANNUAL AVERAGE PRICES AVAILABLE FROM 1875 TO 1932*



* Data in Tables XXV–XXVI.

upper section are plotted the differences, in cents per pound, between annual average prices of lard and of compound and cottonseed oil, respectively; in the lower section the same annual average prices of compound and cottonseed oil are expressed as percentages of annual average prices of lard for corresponding years. Whereas compound prices, prior to 1920, had averaged between 70 and 90 per cent of lard prices, in 1922–24 compound averaged about 5 per cent dearer than lard. Cottonseed-oil

prices were similarly unprecedentedly high in proportion to lard prices, particularly in 1923.

Clearly in 1922–24 two sets of variables acted simultaneously toward the same result; and the problem becomes one of determining, if possible, the relative weight each contributes to the outcome. In this we are hampered by the brevity of the period in which satisfactory statistics on the compound industry are available. Hence quantitative data must be supplemented by reasoning from the known circumstances surrounding the production of lard and compound.

Lard is essentially a joint product, and the compound industry is essentially a by-product industry. This means that conditions governing the supply of both products are unlike those characteristic of primary products. The actual or anticipated price of lard is not a major factor in determining the volume of its production, although, as one source of income from hog slaughter, it is reflected in the price of live hogs. The supply of cottonseed, the basic raw material for non-lard shortening, is largely independent of influence from the forces which control the demand for cottonseed oil and compound.[1]

So far the parallel goes. Beyond that, however, there are important differences. The buyer of cotton does not ordinarily buy the seed. That is marketed separately. If the prices, or prospective prices, for the products of cottonseed crushing are exceptionally low, a smaller percentage of the seed will be purchased and crushed. This percentage is determined largely by the prospective price of cottonseed oil; in the determination of this price the pros-

[1] This statement is perhaps subject to the modification that cotton planters may take into consideration the probable contribution to their income from cottonseed in reaching their decision as to the acreage which they will plant. As a matter of fact, the ratio which the value of seed bears to the total farm value of lint and seed has, in recent years, been not far below that obtaining between lard and total products obtained from hogs. This is indicated by the

pective price of compound is a very large factor. Since most compounders do not operate under conditions of joint cost and cannot, therefore, produce compound for long below total cost,[1] conditions in the compound industry promptly affect cottonseed-oil prices and through them the price of seed and the volume of seed crushed. So brief is the manufacturing process for compound that production can be contracted or expanded on short notice. A producer of vegetable compound may receive an order by one o'clock in the afternoon and have it manufactured and packed for shipment by the next morning, provided he has on hand a supply of hydrogenated oil with which to harden the cottonseed oil.

Lard production, on the other hand, is relatively in-

---

following data (for hog products) from *Biennial Census of Manufactures* and (for cotton) from *Commerce Yearbook, 1932*, I, 161, and *Crops and Markets*, April 1933, X, 149.

Year	Value (million dollars) Hog products	Lard	Percentage of lard to hog products
1921	1,109[a]	190.4	17.2
1923	1,302[a]	263.9	20.3
1925	1,548[a]	279.6	18.1
1927	1,405	234.9	16.7
1929	1,578	248.0	15.7
1931	1,000	149.4	14.9

Year	Farm value (million dollars) Cotton lint and seed	Cotton seed	Percentage of seed to total
1921–22	780	104.6	13.4
1922–23	1,268	150.4	11.9
1923–24	1,645	190.0	11.6
1924–25	1,767	206.2	11.7
1925–26	1,798	220.4	12.3
1926–27	1,293	172.1	13.3
1927–28	1,515	207.0	13.7
1928–29	1,529	226.9	14.8
1929–30	1,446	200.5	13.9
1930–31	795	135.8	17.1
1931–32	556	72.4	13.0

[a] Excluding "cooked hams" which are included in part under "smoked pork" and in part under "miscellaneous products." In 1927, 1929, and 1931, respectively, this item amounted to 49, 58, and 37 million dollars.

[1] Many non-packer producers of compound likewise operate under conditions of joint cost, in so far as they are producers of salad oil or soap. This involves a more or less arbitrary allocation of certain costs which will permit, as in the case of the packers, some deviation from the cost-of-production principle of supply price. However, since these products are usually few in number and since, as stated above, compound is by far the most important for the majority of such producers, the latter must be relied on, in the long run, to bear at least its full share of the cost burden.

sensitive to conditions in the fats and oils market. The volume of hogs produced and slaughtered is less affected by prices of lard than by the size of the corn crop. To be sure, growers may market their hogs at heavy or light weights, thus causing some variation in the quantity of lard obtained per animal. Beyond this, packers may vary the output of lard by selling more or less fat with cuts of meat, depending on the relative price of the two products, or they may market lard as white grease. On the whole, however, when there is a heavy production of pork, there is likewise a large output of lard. Packers and other slaughterers buy the entire animal; the maximum return will be realized by marketing as advantageously as possible every portion which can be made to yield a price above the direct costs incident to processing that portion. Lard production and prices, therefore, tend to behave in a manner that is characteristic of a by-product industry or of any industry where supply is not closely geared to price, or of one that furnishes a product for which there is a very ready substitute. The same is not equally true of compound.

The enormous foreign outlet[1] which has existed for American lard throughout most of the period since this country became an important lard producer has helped to narrow the fluctuations in domestic utilization; and thereby to reduce, to some extent, extreme variations in price which are to be expected in a product characterized by a fluctuating demand and a supply relatively unresponsive to price changes. While some smoothing of the

[1] Exports of lard fell below a half billion pounds in only six of the 33 years beginning with 1900 (Table IX). Of these six years, four were war years. Since the war, exports (like production) of lard have been on a higher level, and exceeded a billion pounds in 1923. In this period lard prices in Great Britain (our largest market) were almost identical with those in Chicago. This means that exports to that country have, on the whole, been less profitable to packers than domestic sales, despite the greater competition with lard substitutes in the home market (see Clemen, *op. cit.*, 127).

curve of domestic consumption has thus been effected, lard supplies have often varied so widely that apparent per capita consumption of lard has also varied considerably from one year to the next (Chart 14 and Chart 19, pp. 171, 186).

In a country where the standard of living is as high as in the United States, the demand for lard is relatively inelastic. The demand for lard and compound combined is still less elastic. The consumption of semi-solid cooking fats of this character is based on food habits which are slow to change if we assume that the minimum dietary requirements are taken care of. Accordingly, both because lard had a firmly established place among consumers, and because the conditions governing its production make its supply largely insensitive to price changes, we should expect the production of compound rather than of lard to be adjusted so as to bring total output of shortening as nearly as possible in line with what the domestic market would absorb.[1]

Application of this reasoning to the years 1922–24 leads to the inference that the output of compound during those years was low not only in consequence of short cotton crops, but also because the great abundance of lard, together with its low prices, in greater measure than usual satisfied the requirements for products of this nature. It is significant that both in 1922–23 and 1923–24 the percentages of cottonseed crushed were lower than usual (Table I); and it seems highly probable that, had larger quantities of cottonseed been available for crushing, the percentage crushed would have been still lower.

Nevertheless, it is unsafe to assume that in the postwar period, at least, conditions in the cottonseed-oil in-

[1] The failure of United States producers to build up a large foreign market for compound has been commented upon above (pp. 96, 153 *et seq.*). For this reason, total output of compound has been closely limited by domestic requirements.

dustry have played only a minor rôle in determining the volume of compound production, and that the dominant factor has been the lard market. So far as the period from 1922 to 1924 is concerned, cottonseed crushing was undoubtedly affected adversely by the closing of the American Cotton Oil Company about the middle of 1923. Since the mills of this company represented from 8 to 10 per cent of the crushing capacity of all mills in operation at the time of their closing, their withdrawal from production exerted considerable influence on volume of cottonseed-oil output.[1]

Furthermore, although the compound output has not grown in the past twenty years as rapidly as has lard production, neither has the basic raw material, cottonseed, increased in supply to any marked degree in the same period, although average output in the eight years 1924–25 to 1931–32 was greater than for any other period of equal length (Table I). Prospects that the American cotton crop will increase greatly in the near future are not bright. The very low price of cotton during the depression has led to some contraction of acreage, and efforts now being made, under the Agricultural Adjustment Act of 1933, to bring about a sharp contraction were fairly successful in 1934. Despite an acreage reduction of about 25 per cent, other conditions were favorable, so that a small but not a markedly short crop resulted. Under existing national policy, very material curtailment of cottonseed and oil is not unlikely to occur over a period of years. Moreover, for some years there has been under way a profound revolution in American cotton growing, connected with more extensive methods of cultivation and with mechanization. Whether the ultimate outcome

[1] The Southern Cotton Oil Company was also in financial difficulties in 1923, but reorganization was apparently accomplished without much interruption of its activities.

will be a larger or a smaller American cotton crop, and therefore whether in the long run compounders will have access to a larger or smaller supply of cottonseed oil, it is impossible to foresee.

Yet this is an important factor in forecasting the possibilities of an increase in compound output, since compounders are, in the main, a part of a highly integrated industry and the compound industry proper is built around cottonseed crushing and cottonseed-oil refining. Vegetable-shortening manufacture is not an industry that stands by itself. Unlike soap manufacture, the industry does not draw its raw materials from whatever source is at the moment most advantageous. Vegetable shortening is primarily a method whereby crushers and refiners market cottonseed oil. Accordingly, there has been no great incentive to increase output of compound beyond the amount which provides an outlet for the bulk of the annual crush of cottonseed.

In recent years, the volume of compound produced has ordinarily been large enough to serve this purpose; quantities of edible cottonseed oil such as formerly went into products like soap, or into export, are being used for various food purposes. With lard production increasing as it has (see Chart 14, p. 171), there has been little incentive for compound manufacturers to become more aggressive. If lard production were to become stationary or to decline, there might be inducements to increase compound production by more largely supplementing cottonseed oil with other oils.

However, under such conditions, the increment produced would face the competition of lard withheld from export. The compounder would not have a free field; he might hesitate to enlarge his output much by using other oils. In the United States, there is hardly any other domestic oil available in quantity, except some fish oil.

Upon the two foreign oils most readily available, peanut and soy bean oil, high tariffs have been imposed (Table XIX). Oils that might be available upon which there is no tariff are palm oil, coconut oil from the Philippines, and shea butter, while on whale oil there is a tariff of 0.8 cents a pound. Compounders would have to fear that any enlargement of their output through the use of other oils might be possible only temporarily, because in recent decades Congress has usually imposed a duty upon an oil or fat as soon as its importation became of significant size.

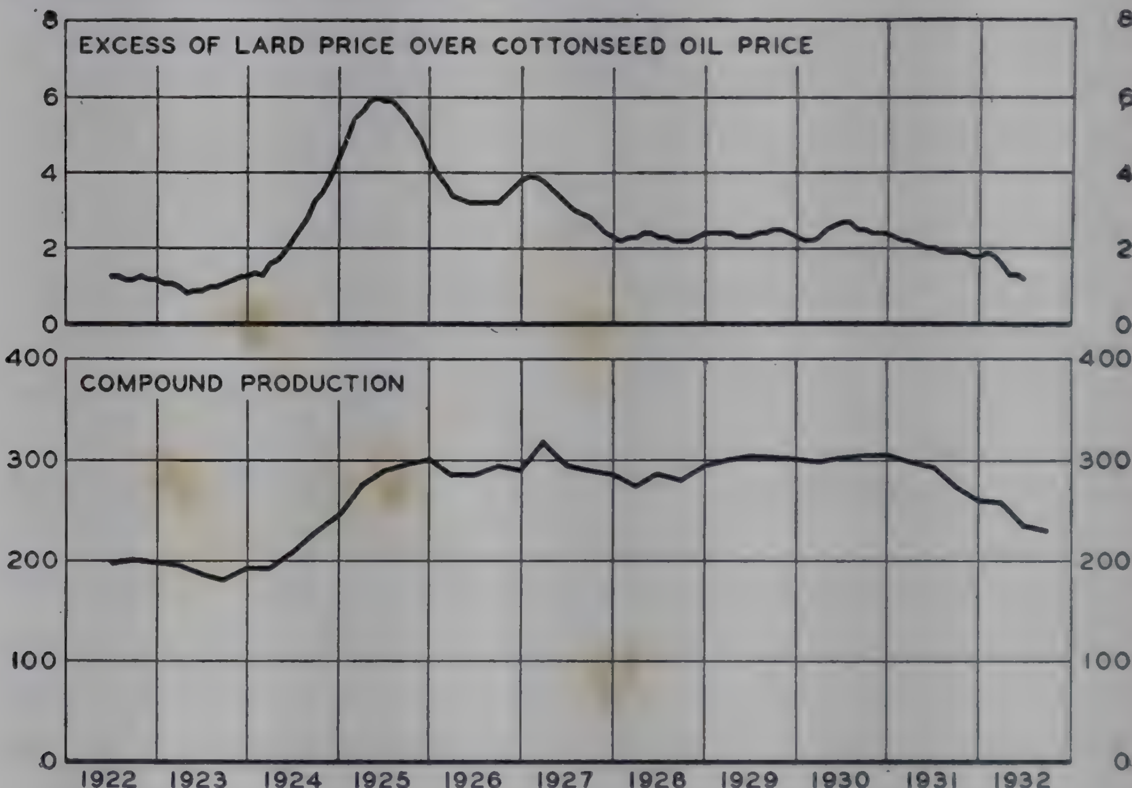
In a pecuniary society, price is not to be ignored in any analysis of factors affecting the volume of output of a commodity. Compound production appears to bear a closer relationship to the spread in price between cottonseed oil and lard than to the absolute price of the latter. This reflects the greater elasticity of demand for compound as its price falls below lard. Undoubtedly, the same is true of lard when the price falls below compound. But the absolute magnitudes of the two prices also have an influence. This conclusion is supported by inspection of the data plotted on Chart 16 (p. 180), which shows production of compound and excess of the prices of lard over those of cottonseed oil from 1922 to 1932. In order to minimize seasonal influences, all series represent moving annual averages of quarterly or monthly data.

The striking similarity of the swings both up and down is readily apparent. The coefficient of correlation between compound consumption and the excess of prices of lard over prices of cottonseed oil, for the period 1922–30, is fairly significant—above +.8. This serves to confirm the conclusion that the factors which we seek to explain are the resultant of forces reflected chiefly in two important relationships which themselves are interdependent. In such a situation it is not possible to isolate

and to weigh the several forces separately. We can only say that the supply of hog fat and of cottonseed oil together constitute the potential stocks from which the demand for cooking fat may be satisfied, and that the price ratio between them at any time is the resultant of their respective outputs, each price modified in part by the other. When this relationship results in a considerable margin in the price of lard above cottonseed oil, the production of compound is stimulated; when the spread is small, or non-existent, the output declines.

Chart 16.—Spread between Prices of Lard and Cottonseed Oil, and Production of Compound, 1922–32*

(Moving annual averages of monthly price data, in cents per pound, and of quarterly production data, in million pounds)



* Based on data in Tables VIII, XXI, and XXII.

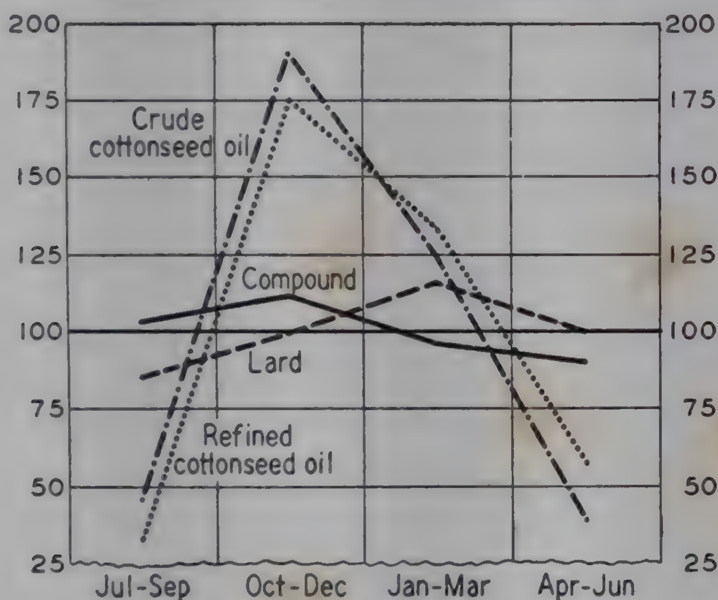
Seasonal Variations—Production, Consumption, and Prices

There are characteristic seasonal variations in the production, consumption, and prices of compound and

lard, but these are far less pronounced than in the production of cottonseed oil. A rough indication of the seasonal variation in the production of these products is shown in Chart 17.

Production of crude cottonseed oil is lightest in the second quarter of the calendar year, and is still light in the third quarter, when mid-crop supplies of seed begin to be available; it is heaviest in the October–December quarter, and much reduced though still heavy in January–March. Production of refined cottonseed oil is light in the second quarter, and still lighter in the third. Here too a peak is usually reached in October–December, but production falls off less severely in January–March.

CHART 17.—SEASONAL INDEXES OF LARD, COMPOUND, AND COTTONSEED OIL PRODUCTION, 1922–32*



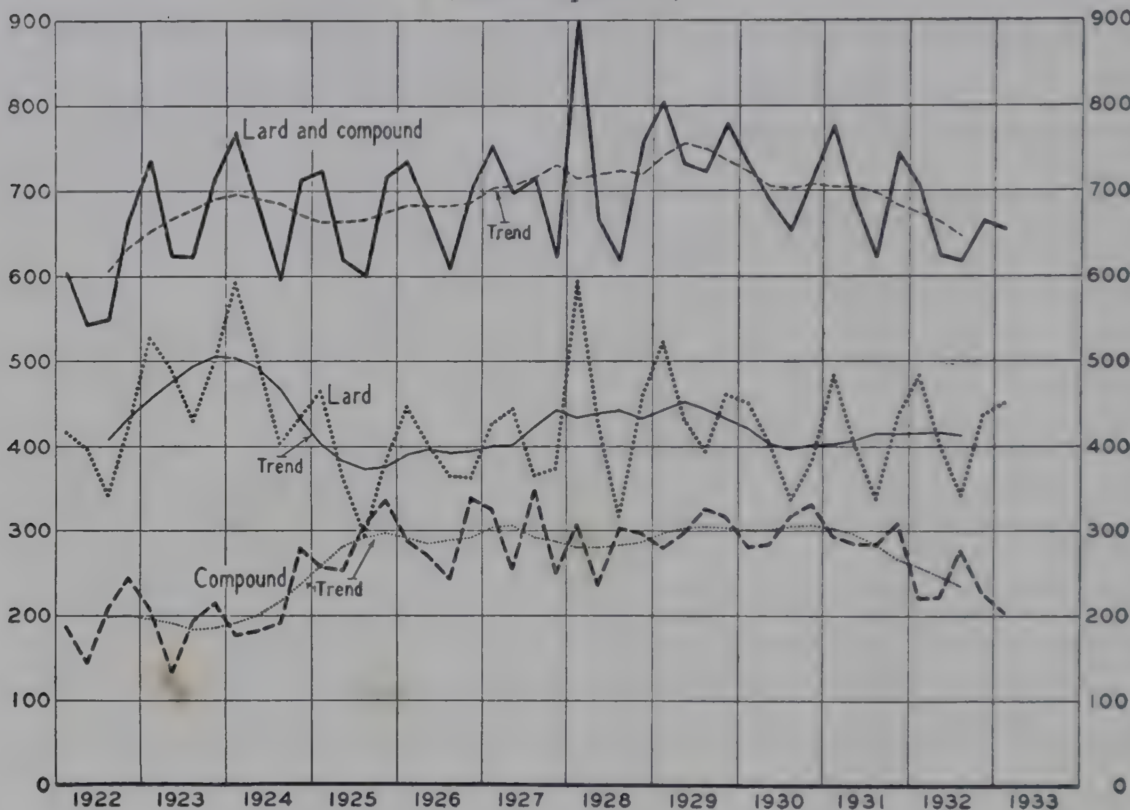
* Based on quarterly data in Table VIII.

By comparison with either crude or refined cottonseed oil, seasonal variation in the production of both lard and compound is moderate. An indication of the extent and character of this variation is given in Chart 18 (p. 182), which shows the quarterly production data for compound and factory-made lard with trends computed as a four-quarter moving average, slightly smoothed.

On the average, compound production is highest, and almost invariably farthest above its trend line, in the fourth quarter of the calendar year, as is true of refined cottonseed oil. In the January–March quarter compound production is almost invariably lower, and on the average below its line of trend. In the second quarter it is usually lowest, and almost invariably farther below its line of

CHART 18.—FACTORY PRODUCTION OF LARD AND COMPOUND, QUARTERLY, 1922–33, WITH TRENDS*

(Million pounds)



* Based on quarterly data in Table VIII. Trend lines are 4-quarter moving averages further smoothed by averaging each two successive 4-quarter averages.

trend. In the summer quarter, however, when output of refined cottonseed oil is typically at a minimum, compound production is usually higher and commonly above the line of trend, though two conspicuous exceptions appear in 1924 and 1926.

The increased production of compound in the summer quarter is related to the fact that lard production is typi-

cally lowest in that quarter. Lard production tends to be heaviest in the January–March quarter, following seasonally heavy slaughter of hogs in the late fall and early winter; to decline in the second and third quarters, and rise in the fourth.

Seasonal variations in consumption appear to be similar for lard and compound. The apparent consumption of all shortening is characteristically heaviest during the fall and winter quarters, and lightest in the summer quarter. Allowing for a lag of a month or so between disappearance and ultimate consumption, this fits well with the expectation of a higher consumption in the colder months. Compounders are thus fortunate in having the period of most abundant supplies of raw material and greatest volume of output correspond closely with the season of heaviest demand for shortening. They must, however, draw upon stocks of refined oil during the late spring and early summer, until fresh supplies from the new crop are available in the late summer and fall. Lard producers, on the other hand, reach their peak of production somewhat later and so must accumulate heavy stocks of the finished product during the spring and summer months. This puts them at some disadvantage in their competition with compound, since it involves carrying the product over a considerable period of time, and subjects them to greater risks from price changes. Against the latter, however, lard producers may in some measure insure themselves by hedging in lard futures on the Chicago Board of Trade. While compounders may gain some protection against price changes by hedging their purchases of cottonseed oil on the New York or New Orleans futures markets, it is said that the insurance thus secured is of limited effectiveness owing to the comparatively small volume of future sales of cottonseed oil.

Seasonal variations in *prices* of lard, compound, and

cottonseed oil are much less pronounced than in production. They are so moderate, indeed, by comparison with changes due to factors other than seasonal influences, that it is impossible to isolate the results attributable to seasonal factors with sufficient accuracy to derive reliable indexes of characteristic seasonal variations in prices. Computations for different periods of years yield divergent results.

Indexes based on monthly prices for 1922–29 showed variations apparently assignable to seasonal influences amounting to only 2 or 3 per cent above and below the level established by factors other than seasonal. Lard prices appeared seasonally highest from June to November, and seasonally lowest from December to May; while compound prices appeared seasonally highest in March–May and September, and seasonally lowest in October–February and June. But the limited extent of the average seasonal variation in prices reflects the facility with which stocks can be carried at moderate cost, and to some extent the feasibility of adjustments through production or exports.

Lard, compound, and cottonseed-oil prices all show a smaller seasonal variation in the post-war decade considered, as compared with the first eleven years of the present century.[1] This may be accounted for, perhaps, by better marketing methods, greater standardization in use, or more stable general price conditions. The prices of cottonseed oil before the war fluctuated more during the year than those of the other two products, while lard prices varied the least. Since the war, however, the price of compound has been subject to much smaller seasonal variation than in the earlier period. This increased seasonal stability of prices of compound may be attributed

[1] This is measured by taking the mean deviation of the monthly variations from the seasonal price index.

in part to the development of a more independent demand for it, as a result of wide advertising. Moreover, with improvements in process, particularly hydrogenation, the supply made available on the market can be more quickly adjusted so as to minimize pending or actual changes in the market. Finally, production of compound is subject to smaller seasonal variation than that of lard.

Per Capita Consumption of Lard and Compound

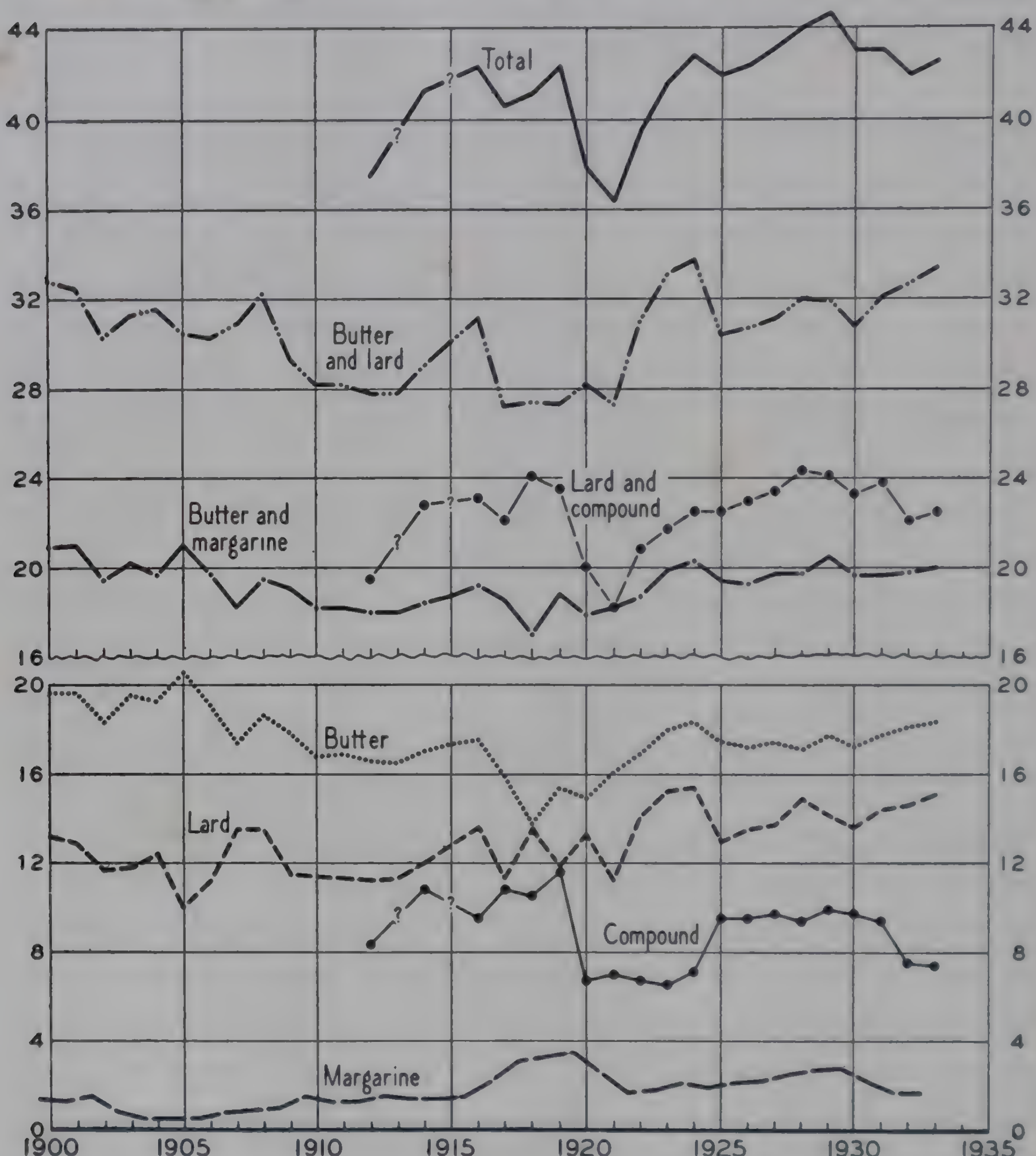
Unfortunately, as Zapoleon and Taylor have pointed out,[1] the statistics on lard production are quite uncertain, partly because little is known concerning the lard yields from hogs slaughtered without federal inspection, and partly because the number of hogs so slaughtered is not enumerated but merely estimated. It is, therefore, not possible to make a trustworthy comparison of per capita consumption of lard and compound. The best that can be done is to take the available data as they are and keep in mind that any inferences drawn are wholly tentative—might, indeed, be found unwarranted were more reliable data available.

If the estimates of lard production published by the Department of Agriculture (Table IX) may be accepted as good approximations, per capita lard consumption has been on a higher level since the war than it was in the first fifteen years of the century (see Chart 19, p. 186). During these fifteen years, there was no consistent rise in this figure. In fact, successive five-year averages show a decline from 12.4 pounds for the five years 1900–04 to 11.9 pounds during the next five years, and a further drop to 11.5 pounds for the years 1910–14. The trend of per capita lard consumption over the period 1900–14 was downward at the rate of about 0.07 pounds per year. This apparent decline is somewhat at variance with consumption

[1] Zapoleon, *op. cit.*, 39, 41, 160–66; Taylor, *op. cit.*, 86.

figures of pork (other than lard), which rose slightly per person in the same period.[1] During the war years, per capita consumption of lard increased somewhat; but it

CHART 19.—ESTIMATED PER CAPITA CONSUMPTION OF BUTTER, LARD, COMPOUND, AND MARGARINE, 1900–33*



* Data in Table XX.

remained for the years 1923 and 1924, following record swine slaughtering, to mark a high point in the per capita

[1] See sources cited for Table IX.

lard consumption of more than 15 pounds. Since then, consumption relative to population growth has diminished, averaging annually about 14 pounds per person. Pork (other than lard) consumption for this post-war period has likewise been considerably in excess of pre-war figures. This apparent increase in per capita lard consumption, however, may not indicate increase in total consumption of hog fat. It may merely mean that more of it is consumed as lard and less in cured-fat products, such as salt pork. This hypothesis is supported by the fact that the relation of lard to total pork and lard produced under federal inspection has risen from 20.2 per cent in the pre-war period to 22.5 per cent in the post-war period. It may be that Americans are now consuming relatively more of their intake of hog fat as lard and less as salt pork. This question is discussed further below (p. 190), in connection with the per capita consumption of lard and compound combined.

It is impossible to make any systematic comparison of the per capita consumption of lard with that of compound in the pre-war period, since no figures on production of the latter are available before 1912, and the estimate for 1912 is questionable. Some idea of the volume of output might be obtained from cottonseed-oil statistics. The unofficial Aspegren consumption estimates for eleven years ending July 31, 1912 (Table II), provide a basis for per capita figures of cottonseed oil used in compound and otherwise for cooking and baking. These show an increase of 0.11 pounds per capita in this period.

There are some reasons for believing that the actual rate of increase in the pre-war decade and a half may have been greater than indicated by this figure. The Food Administration's estimate of cottonseed oil consumption in lard substitutes in 1912—866.7 million pounds[1]—yields

[1] U.S. Department of Agriculture, *Bulletin 769* (1919), p. 15.

a per capita figure slightly over 9 pounds. This is considerably higher than the per capita figure of 6.62 pounds for use in compound and in cooking and baking derived from Aspegren estimates. The Food Administration estimate of compound production in 1912 itself seems low, in the light of their estimates for 1914 and 1916–18. The apparent decline in per capita consumption of butter in 1900–14, of butter and margarine combined, and in lesser degree of lard itself (Chart 19, p. 186), may easily have been accompanied by a rise in compound consumption of at least 3 or 4 pounds per capita in this period. But the available data are insufficient to yield trustworthy approximations.

There is good reason, however, to trust the evidence of Chart 19 that in 1914 and 1917–19 compound consumption reached its highest per capita level, and most nearly approximated that of lard. In 1920–24, however, compound consumption fell to a level much lower than it had been in the six years preceding (compare Chart 9, p. 107). Between 1924 and 1925, however, the recovery in compound consumption exceeded the sharp decline in lard consumption. Between 1925 and 1931 per capita consumption of compound was on a fairly constant level somewhat lower than in 1914 and 1917–19; but in the past three years of depression some decline has evidently occurred (see Chart 19, p. 186).

If one accepts the none-too-reliable data at their face value, per capita consumption of lard and compound combined appears to have reached a high level in 1918 and 1919, fallen sharply in 1920 and 1921 to very low levels, recovered sharply in 1922, and risen more gradually in succeeding years to levels in 1928 and 1929 slightly exceeding those of 1918 and 1919. During the present depression, a decline has occurred, but it has apparently been less severe than in the depression shortly following

the war, when Europe took large quantities of both lard and compound. Significant percentages of per capita compound consumption to the consumption of lard and compound combined, by groups of years, are as follows:

Years	Percentage
1914, 1916–19	46.0
1920–24	32.9
1925–29	40.9
1930–33	37.1

It is unfortunately impossible to extend the comparison back into the pre-war period, and thus to compare the level of compound consumption in recent years with that of the decade before the war.

As one would expect, the curve showing consumption of lard and compound combined is smoother than the separate curves for lard and compound. With rare exceptions, indeed, year to year variations in the two series are inverse. This clearly indicates a powerful interdependence between lard consumption and compound consumption, though the level of the combined consumption appears to be largely dependent on other factors.

Chart 19 also gives per capita consumption estimates for butter (which cannot be regarded as very reliable) and for margarine (by fiscal years). Taking these at their face value, they appear to show a prolonged decline in per capita consumption of butter to a low level during the war; a lesser decline in consumption of butter and margarine combined during 1900–14; and a notable increase in subsequent years. The uppermost curve in the chart suggests that per capita consumption of these four major food fats had recovered by 1924 and 1925 to the level of 1918 and 1919; and that it subsequently rose to levels in 1928–30 that were as high as or probably higher than early in the century, before the margarine and compound industries were as large factors as they later became.

Because of uncertainties regarding the data for butter and lard, one cannot be sure that the chart presents a true picture. If, however, recent years have actually witnessed an upward trend of the combined consumption of these four food fats, this represents a noteworthy shift in the American dietary. It does not support the assumption which has often been made that there is a tendency for the amount of fat in the diet to decline, but would seem to indicate that the reverse has occurred. However, an increase in per capita consumption of these fats may mean merely that they are displacing some other fatty constituents of the diet, rather than that the fat content of the diet as a whole is increasing. It is probable that the marked preference for lean rather than fat meats which has been developing in the public taste for nearly two decades is one factor responsible. It may be that formerly a large part of the fat ration was ingested in the form of fat meats, whereas now the deficit that results from the preference for lean meats is made up in part by the use of lard and compound. This would be consistent with changes in the manner of living that have been going on. It would be expected to result from greater urbanization and the disappearance of the frontier, with the workers in lumber camps, on the range, and in mining camps no longer so distant from the towns. The replacement of the old-world methods of cooking of the immigrant by the more luxurious methods of his children, and the general increase in luxuriousness of the American dietary would work out in the same direction.[1]

Possibly, also, a portion of the fat ration formerly ingested in fat meats is now replaced by fat and by vegetable oils used as such. The fact that there has been a marked increase in consumption of fruits and vegetables would reinforce such a tendency to consume fat as such

[1] Taylor, *op. cit.*, 429–30.

rather than as a part of the meat ration. In preparation for the table, cooked vegetables usually require fat; they require oil if consumed as salads.

Perhaps an important factor has been the growth of commercial baking, for the commercial baker has tended to use more and more shortening, partly to bake a richer bread, partly because of more extensive baking of sweet goods. The housewife whose product he has been displacing has, to be sure, also used shortening, but she has used more butter, and probably more margarine, than the baker. Increasing reliance upon commercial bakeries, therefore, may have caused some growth in per capita lard and compound consumption at the expense of butter, margarine, and other fats used by the housewife for similar purposes in cookery. This consequence of the rise of commercial baking may not be inconsiderable. In 1929, according to the Bureau of the Census data on materials used in this industry, commercial bakers reported the use of 563 million pounds of shortening, of which 45 per cent was lard, 21 per cent lard substitutes, and 9 per cent butter substitutes, and 25 per cent other shortening agents (Table XIV).

The importance of the bakery outlet for both lard and compound is suggested by the tabulation below[1] in million pounds:

Product	Total domestic consumption		Reported bakery consumption		Percentage in baking industry	
	1927	1929	1927	1929	1927	1929
Lard	1,639	1,732	176.7	253.4	10.8	14.6
Compound	1,223	1,243	133.6	117.8	10.9	9.5
Both	2,862	2,975	310.3	371.2	10.8	12.5

Since baking establishments with annual sales under $5,000 are not included in the data reported by the Bu-

[1] Based on data in Tables V, IX, X, XV.

reau of the Census, and since not all those covered reported in detail on the use of materials (see Table XV), the consumption of lard and compound by the entire baking industry is somewhat greater than these figures indicate. Clearly the industry is a factor of some weight in influencing national consumption of the several shortening agents.

For the other large group of extra-household consumers of shortening, namely public eating-places, there are not even estimates of the amounts of lard and other fats used. In so far as such establishments use lard and compound in cookery where in the home butter and margarine are employed, the increasing patronage of such places would also tend to increase per capita consumption of lard and compound.

Shifts in the dietary, such as that toward increasing use of compound and lard here under discussion, are by no means unprecedented. Thus for butter, such data as are available indicate that annual per capita consumption in the United States was on about the same level in 1903 as in 1887, 19.0 pounds, the range being from 19.0 to 19.9 pounds; it then dropped gradually to 16.5 pounds in 1914, and below 15 pounds during the war; since 1920 it has risen to over 17 pounds.[1]

How long the combined consumption of lard and compound will continue the orderly behavior of the last decade, it is manifestly impossible to say. We are justified in saying, however, that the available post-war data indicate that the factors affecting the volume of compound production are still in considerable measure those which appear to have governed it throughout most of its history. Accordingly, it seems reasonable to expect a continuance of similar relationships for the near future, at least. On the demand side, it fully accords with what would be

[1] Snodgrass, *op. cit.*, 310, 311, and Table XX.

anticipated. The supply of both products, however, is involved with factors only remotely connected with the market for edible fats, and the result is likely to be a certain waywardness of behavior from time to time.

In the light of these observations, the failure of compound to make appreciable gains in volume of output is completely understandable. The trend of lard production has been upward at a rate of growth greater than that of the population. As a result, lard substitutes have found little room in which to expand in the domestic market, and the foreign market is limited by the preference there prevailing for other types of cooking fat and by keen competition from our own lard exports. It must not be concluded from this, however, that the compound industry has failed to strengthen itself during the years when its growth has been of very modest proportions. Its gains, as we shall see, have been rather in the field of price.

Household as Compared with Commercial Consumption

The compound industry finds its largest market now, as formerly, among industrial and commercial users. In spite of extensive and intensive advertising of retail brands of non-hog shortening put up in small packages, the bulk trade probably amounts to at least twice that distributed through retail groceries.

Beginning with the biennial Census of Manufactures for 1925, we have a division of the compound output of establishments engaged primarily in the production of this shortening, classifying package goods in units of eight pounds and under separately from other output in containers holding over eight pounds (Table XIII). Percentages of the output of each of the two classes of compound, and the two combined, that was sold in units of over eight pounds were as follows:

Materials of compound	1925	1927	1929	1931
Vegetable oils and fats only	67.6	61.8	67.7	63.5
Animal and vegetable oils and fats	66.8	66.1	59.3	54.4
Total	67.3	63.1	65.9	61.0

The data for 1931 (Table XIII) show a material increase in the amount of compound marketed in packages of eight pounds or less (especially of compounds containing animal fats), and a substantial falling off in the quantity of compounds (in total and from vegetable materials) marketed in larger units. This presumably reflects the influence of the depression in reducing consumption in public eating-places, in causing more home cooking, and in pressure toward economy. Even in 1931, however, 61.0 per cent of the total output of this principal branch of the industry was marketed in the larger units. Moreover, since eight-pound packages are not widely handled by retail grocers, it is probably safe to estimate the percentage of total output usually marketed among household consumers as nearer one-fourth than from one-third to 40 per cent of the total.

It will be remembered that an early producer of retail and bulk brands of lard compound sold twice as much of the latter as of the former (see above, p. 75). The conditions which account for the preponderance of commercial and industrial outlets in both periods are, however, not the same. In the early years of the compound industry, the new product had to contend with ancient household habits, and with prejudices fostered in part by those whose chief interest lay in strengthening the position of lard. Legitimate prejudice was likewise created among retail consumers by the circumstances which determined that compound had had its origin in lard adulteration. Accordingly, it made most rapid head-

way among industrial and commercial consumers, with whom price is paramount and prejudice yields easily to anticipations of profit.

In the recent period, on the other hand, the industry (like many another) has witnessed a steady shift of functions and activities from home to factory, which has been accelerated since the war first called women into many new occupations. The great expansion in commercial baking is clearly shown by the Census reports.[1] The rapid urbanization of population, as well as the increasing participation of women in gainful occupations outside the home, has led also to a relative decline in all other forms of cooking in the home. The growth in number and patronage of hotels and restaurants testifies to this fact. The reversal of this tendency in the present severe depression can be regarded as temporary.

Modern city homes with small space for supplies and relatively limited cooking activities may influence the household consumption of lard and compound in another way. Since butter and margarine, and perhaps liquid vegetable oil, are almost certain to be kept on hand where any cooking is done, they may come to be utilized for shortening or frying even though purchased primarily for other purposes.

There is no way known to the writers of estimating the decline in the average volume per household of purchases of cooking fats, but it may now very easily be one-fourth to one-third less than it was a generation ago, in spite of increases in per capita consumption. Indeed, when consideration is given to the great expansion in the output of establishments devoted to bread and other bakery products, as well as to the multiplication of hotels and

[1] See H. Kyrk and J. S. Davis, *The American Baking Industry, 1849–1923, as Shown in the Census Reports* (Miscellaneous Publication of the Food Research Institute, No. 2), September 1925, and census data for 1925–31.

restaurants, one might be warranted in estimating a still greater decline.

From the data which show both quantity and value of lard substitutes marketed in small and large packages, the average wholesale value per pound of the two groups of products can be calculated as shown below in cents per pound (Table XIII).

	Vegetable compound			Compound containing animal fats		
Year	Small	Large	Difference	Small	Large	Difference
1925	13.7	12.6	+1.1	13.8	12.7	+1.1
1927	12.7	10.8	+1.9	12.6	11.0	+1.6
1929	13.0	11.3	+1.7	12.4	11.1	+1.3
1931	10.0	8.4	+1.6	9.1	8.1	+1.0

For both the vegetable shortening and that containing animal fats, in each of the last four biennial census years, the average unit value at the factory of the commodity marketed in small containers has exceeded that of the larger by amounts ranging from 1.0 to 1.9 cents per pound, the difference being usually larger in the case of purely vegetable shortenings. The decline in unit value between 1925 and 1927 was greater in the bulk product, but between 1927 and 1929 the rise was likewise greater. Between 1929 and 1931, on the other hand, the decline was somewhat greater in the price of the small-package goods.

These differences in price and in price behavior may be explained in several ways. If prices are regulated strictly in accord with differences in cost, it would be expected that the price of those products which are marketed in small packages would be higher, because of the obvious difference in packing and marketing cost per unit of product. An explanation which approaches the subject from the demand side is that retail demand, particularly for widely advertised brands, is undoubtedly less elastic than is demand from commercial or industrial sources,

and is less subject to clear-cut competition, so that such a product may usually be marketed at some premium over the strictly competitive price. One of the prime purposes of trade-marked brands and national advertising of commodities going into retail distribution is to create a dependable demand from ultimate consumers which will support a sustained or increasing volume of output at stable prices. Accordingly, it is to the interest of the producer to absorb minor and temporary fluctuations in costs in order to avoid disturbing the trade and unsettling the opinion of the consumer as to what is a fair price for the product in question. For these reasons, it appears entirely logical to find that the price of the small-package goods is likely to be better sustained in a declining market than that of large-package goods, and that price fluctuations are of smaller range. The exception noted in the greater relative decline between 1929 and 1931 in the price of compound packed in small containers is probably a temporary phenomenon arising out of special conditions of recent years.

Price Relationships

The close interrelation of prices among fats and oils is a fact of sufficiently wide recognition to justify taking it for granted here. The problem claiming our particular attention is the behavior of prices of the several fats and oils most intimately connected with the compound industry. These are cottonseed oil, oleostearin, lard, and compound. Two of them, lard and cottonseed oil, are likewise factors of fundamental importance throughout the entire fats and oils situation in America; and their production and price trends are closely watched by those interested in the market for inedible as well as for edible fats.[1] For

[1] See Zapoleon, *op. cit.*, 262.

present purposes, however, these four need be considered only in their bearing on the compound industry.

Monthly average prices for lard and cottonseed oil from 1875, and of oleostearin and compound from 1892 and 1897 respectively, have already been presented in four charts for 15-year periods. A glance at the charts shows, according to expectation, an extremely close correspondence in the price movements of lard and cottonseed oil. The spread between them, however, varies greatly, and is practically always greatest when lard prices are exceptionally high, and smallest when lard prices are at or near bottom. For the most part this behavior characterizes the entire period up to the present.[1]

It is interesting to note that the average excess of lard prices over cottonseed-oil prices was the same for the last twenty years of the nineteenth century (2.6 cents) as it was for the ten post-war years, 1923–32. As stated above, however, this differential has by no means been uniform; in the fourteen years 1901–14, it amounted to 3.9 cents. The widest average spread occurred in the years 1915–21, but this was in a distinctly abnormal period.

Monthly prices of oleostearin and compound have been obtainable with regularity since 1892 and 1897, respectively. Beginning with the new century, therefore, we may observe the mutual relations in the prices of all four products.

From 1900 to the outbreak of the war, the two animal fats, lard and oleostearin, maintained substantial price differentials above compound and cottonseed oil during all but a comparatively few months. Oleostearin followed closely the major movements of lard, although its price changes were decidedly more extreme. On the upswings, it almost invariably rose considerably above the level

[1] The war years, during much of which prices were kept at a level established by the government, will be disregarded in the present discussion.

reached by lard, and when the latter declined, it fell somewhat farther. On the whole, during these years, oleostearin was the highest-priced fat among the four, averaging nearly half a cent a pound above lard. The latter exceeded compound in price by about 2 cents, and cottonseed oil by nearly 4 cents.

A careful comparison has been made of the monthly prices of lard, compound, and cottonseed oil for the fifteen years preceding the war, and also for the nine years 1922–30. These data were corrected for seasonal and secular trend, so that the price behavior peculiar to any one commodity, as a result of seasonal or long-time factors, might be eliminated. In both the pre-war and post-war periods, the variations in prices of cottonseed oil and compound show a marked correspondence,[1] thus indicating that the intimate relationship between the two has not been subject to any measurable modification. This correspondence is, of course, what one would expect to find, not only because cottonseed oil constitutes so large a percentage of the cost of the manufactured shortening, but also because of the vertical organization of the major producers of the industry. Since these producers usually control the product from crushing through the manufacture of cooking fat, the price differentials between products in the several stages tend to relative stability.

The prices of lard, on the other hand, show a less close connection with either of the other two series, even in the pre-war period. During the first fifteen years of the century, lard-price fluctuations rather consistently preceded those of cottonseed oil and lard compound by some two

[1] Correlation of these two series yielded a coefficient above +.9 in each period calculated separately. The method used was as follows: A line of trend was established from the annual average prices. Then, from the original monthly price data a twelve-months' moving average was calculated. The actual deviations of the latter in cents per pound from the line of trend were used in computing the correlation coefficients.

or three months. During the post-war period, however, close correspondence in behavior of cottonseed oil and compound prices with those of lard seems to have disappeared.[1] The failure of lard and compound prices to show similarity of movement in the period from 1922 to 1930 must not, however, be taken to indicate that the two series are mutually independent. The relationship is rather one of interdependence, but one which tends to be obscured by the fact that the supplies of lard and cottonseed oil are, as we have seen, relatively free of influence from forces governing their prices. Thus, output of the one may be unusually great while that of the other is low. This means a tendency toward falling prices for the former and rising prices for the latter. Such a situation will reveal no positive relationship. Nevertheless, it seems certain that the shortage of the one will keep prices of the other from falling as far as they otherwise would, and that, conversely, the large supplies of the abundant fat will check in some measure the rise in price of the scarce one. This is exactly the situation which prevailed between 1922 and 1924. Indeed, so extreme was the deviation in the output of both lard and cottonseed oil from previously established trends that the situation thus created may be largely responsible for the fact that the statistical measure of relationship showed nothing significant.[2] We are justified in concluding, however, that although compound prices are still influenced by lard prices, the position of close dependence which the former held with respect to the latter in the early years of the present century has given way to a reciprocal relationship. Since lard is still

[1] The highest coefficient, +.38 for cottonseed oil and +.41 for compound, was obtained with the no-lag correlations.

[2] The situation might perhaps be clarified by inserting additional variables into our computations. As is so often the case with economic phenomena, however, the gaps in accurate quantitative information make it futile to resort to complex mathematical processes in the hope of arriving at a more precise statement of the facts.

the major product in terms of quantity of output, and since it usually enjoys some premium over compound in price, it doubtless exercises a greater price influence in the cooking-fat field than does compound. Clearly, however, it is no longer dictator.

Certain other significant changes in the post-war period in the matter of prices of this group of fats may be noted from the data. Beginning with 1922, when business was recovering from the depression, we find that oleostearin prices ranged almost consistently below not only lard prices, but those of compound as well, and even below cottonseed-oil prices for much of the time. During these years, it averaged about a half-cent above cottonseed oil. In other words, oleostearin has definitely lost its price superiority and now occupies, on the whole, the least favorable position. There are a number of factors that probably account for this phenomenon. One is that hydrogenation has made compounders largely independent of oleostearin, so that they are in a better bargaining position in dealing with the meat packers who control the oleostearin supply. Another is that margarine manufacturers through the use of coconut oil have become similarly independent of the joint product of oleostearin, oleo oil. Indeed, less oleo oil, absolutely, is now used in margarine than formerly. Both factors, together, would tend to lessen the demand for edible tallow and lower its price. Since less oleo oil is produced, less oleostearin would also be available, and compounders might find it more advantageous to use edible tallow directly rather than its derivative, oleostearin. Data for 1931 and 1932 (Table XVIII and p. 119) indicate that among compounders there has been some shift from oleostearin to edible tallow. These relations have been discussed in some detail in the section on raw materials.

Another interesting change in relative prices has taken

place in lard and compound prices. From the beginning of the century until the outbreak of the war, lard prices averaged 2 cents per pound above those of compound. In the period from 1922 to 1932, on the other hand, this differential has been reduced to about 0.4 of a cent. During four years of this period, the price of compound was actually above that of lard, and the average differential would have been smaller if it had not been for the extremely high lard prices from the autumn of 1924 to the summer of 1926.

Lard prices in the post-war period have suffered in relation not only to compound prices but also in relation to general prices. In the nine years 1922–30 average annual lard prices were about 20 per cent or less above the average for the five years before the war, except in the two years 1925 and 1926 (Table XXI), while prices of other pork products, of butter, of meats, of other foods, and likewise of all commodities considered together, were farther above the pre-war level. Especially is this true of the chief hog products other than lard.

In the light of the reduced differential between lard and compound prices (Chart 15, p. 172), and the approximately maintained differential between cottonseed-oil and lard-compound prices, compounders in recent years appear to have been in a relatively more advantageous position for profit making than they formerly enjoyed. This increased differential, however, may have been gained largely as the result of expenditures incurred in building up a market, so that the net gains may not have been great.

Vegetable shortening products have, of course, ceased to be lard substitutes in their former sense. The two fats are now mutually substitutable in large measure. We may say that there are two constituent elements in the demand for compound. On the one hand, there is the considerable outlet among retail consumers—an outlet which

represents a relatively inelastic demand, and one which is, therefore, little influenced by variations in lard production and price. On the other hand, as we have seen, commercial consumers vary their demand not only with the price of compound and of lard, but also with the spread between the two. Thus, when lard prices are high, compound demand shows greater elasticity than when lard prices are low. The lard market is still a factor which compounders watch closely, but they no longer feel the need for such sensitive adjustments as formerly in accommodation to changes in the lard situation.

It is thus more in the matter of price, and less in the matter of output that the compound industry has made its greatest inroads on the established position of lard and gained a substantial measure of independence from that product. For reasons already outlined, it is likely that so long as the agriculture of the country produces corn and hogs in amounts more than sufficient to keep pace with population increase, the compound industry will have to content itself with an irregular and moderate rate of growth, and that whatever gains are made will mostly be in the realm of price relationships. With the present makeup of the industry, however, most of whose members are packers or cottonseed-oil crushers and refiners, there will probably be no great incentive, as has already been said, toward expansion of output beyond the volume which comfortably disposes of the cottonseed crop. The annual crush now appears to take a relatively stable percentage of the crop (Table I), so that we may conclude that in normal times nearly all the seed that is offered and is in good condition is taken each year by the crushers.[1]

Changes in world supplies of and world demand for

[1] After the large crop of 1931, however, the percentage crushed fell to the lowest point since 1908–09, except for 1920–21.

edible fats may alter the present relation of lard and vegetable shortening in the domestic market. Changes in policy by the packers may likewise introduce new elements, or give a different emphasis to old ones. We may see either a rise or a decline in the world price level for fats, depending on whether production of fats and oils expands more or less rapidly than the demand for them. Any permanent strengthening of the demand relative to the supply would be advantageous to all fats, although not necessarily in equal degree, and would probably make a larger place for the compound industry than present market conditions have enabled it to attain.

The Effect of Compound on the Demand for Lard

The foregoing discussion of price relationships among the several fats and oils most closely identified with the shortening group has demonstrated the change in relative position which has taken place in these products in the years since the inauguration of the compound industry. Some of the reasons for these changes are self-evident; others have already been pointed out, either specifically or by implication. There remains for further consideration the effect of compound on the demand for lard. It has been pointed out that there is little prospect of rapid further growth of the compound industry and that its gains are far more likely to be in a better price position. Such a position can only be achieved by a weakening of the price position of lard. We have now to consider the factors affecting these aspects of the situation.

The decline in household cooking which has been going on in the past generation has, on the whole, exerted an unfavorable influence on the position of lard in its competition with other cooking fats. We have already seen that, because of this decline, the sale of shortening

to domestic consumers has been decreasing relative to that going into commercial and industrial outlets, such as bakeries, hotels, and restaurants. Compound has not been affected by this change to so great an extent as lard because the greatest outlet of compound has probably always been among wholesale consumers. The change itself from retail to wholesale outlets would not have affected lard producers adversely were it not for the fact that the two types of consumers differ, not only in their requirements, but also in the conditions influencing their demand.

Barring butter, lard was the favored shortening of American housewives for generations before the advent of its competitors. Among them, custom and familiarity are much more powerful than price in influencing choice. This is particularly true for any item of expenditure which, over an entire year, amounts to a very small percentage of their total outlay for food. The average annual per capita consumption of lard has probably never much exceeded 15 pounds; that of lard and other cooking fats together has never reached 25 pounds per capita. Even assuming that the entire consumption took place via retail outlets, a difference of two or three cents per pound between lard and other cooking fats would affect the average annual household expenditure for shortening only by as many dollars. So long, therefore, as shortening was sold chiefly to household consumers, lard was reasonably secure in its hold on the market, even at a substantial differential above the price of other cooking fats.

The trend away from household preparation of foods has led to an increasing influence on the market of consumers who are little affected by custom and much affected by price. Here a cheaper vegetable product had, as we have already pointed out, an excellent chance to gain headway, so long as its performance was satisfac-

tory. Commercial and industrial establishments which annually consume great quantities of shortening obviously find even the smallest unit saving of considerable aggregate importance. Among such consumers, lard could not expect to maintain its former supremacy in the face of a cheaper shortening of satisfactory quality.

The matter of price is not the only way in which the rise of commercial cooking has been unfavorable to the position of lard in the shortening market. Large establishments find it of primary importance to obtain standard, uniform, and stable results in order to maintain a market which they have been at pains and expense to build up. To obtain such results, it is clearly necessary to assure themselves of uniformity in the character and performance of their raw materials. Producers of vegetable shortening have made it a point to cater to the bulk trade, not only in turning out completely standardized products, but also in making brands with special formulas to meet the varied requirements of their large customers. In this way, they have further strengthened their position with the bulk trade, already strong because they could usually offer compound at a price somewhat below that ruling for lard.

The packers, on the other hand, appear to have lagged behind in such matters in respect to lard. The properties of lard vary considerably with the time of the year, the breed of hog, the animal's age, and the feed upon which it has been fattened. Until very recently, packers have taken no concerted steps to render the bulk of their lard output strictly uniform. Large consumers have experienced difficulties in obtaining lard of uniformly good flavor and reasonably standard performance. Complaint is made that methods of rendering pay too little attention to securing the best product possible from the fat used. Under such circumstances, it is not surprising that pro-

ducers of lard in recent years have felt keenly the competition of other cooking fats.

It is not only among wholesale consumers of shortening that compound has gained a foothold in the shortening field at the expense of pure lard. Among domestic consumers there has been built up, for certain brands, a demand strong enough to support the sale of these products at prices several cents per pound higher than that of lard. In addition to offering a uniform and high quality product in convenient and attractive packages, these manufacturers have spent great sums on advertising, and have thereby promoted a consumer preference which, in an earlier generation, was enjoyed by lard. Indeed, it is certain that a large, though unknown, number of young housewives today use vegetable shortening exclusively where their mothers used lard.

Another circumstance which has operated unfavorably to the reputation of lard among domestic consumers is the fact that its sale has not been, for the most part, based on demand for specific brands. To a very large number of consumers, lard is lard, and it has often been possible for local retailers to persuade housewives to purchase lard of a distinctly inferior quality turned out by small or nearby slaughterers. When such purchases proved unsatisfactory, the reputation of all lard suffered. Compounds, on the other hand, have been marketed among retail consumers almost entirely through specific brands, so that the shortcomings of one did not damage the reputation of all.

Packers' Efforts to Strengthen Lard Markets

It has been traditional among pork packers to count on the proceeds from lard to pay for the live hog. For many years, they were generally able to achieve this result, but in recent years, in the view of the packers, the

strength of other cooking fats among both wholesale and retail consumers has reacted so unfavorably on the market price of lard that packers are no longer able to count on this relationship between hog and lard prices.

It is easy, however, to overemphasize the depressing effect of compound on the market price of pure lard. While some influence in this direction is indisputable, the fact must not be lost sight of that post-war production and domestic consumption of lard have been on distinctly higher levels than obtained before the war. Quite apart from any competition from vegetable compounds, therefore, a change unfavorable to lard in the ratio between hog and lard prices would be expected, since the demand for lard is undoubtedly less elastic than the demand for pork.[1]

After years, then, in which the lard market was largely left to take care of itself, the packers have begun to concern themselves actively with the problem of adapting their product to meet the changed conditions. It is, perhaps, an instance of poetic justice that the packers, whose early indifference to the quality of refined lard (because they were not themselves refiners) was largely instrumental in producing the conditions which led to the creation of the compound industry, have latterly experienced loss of profits on lard partly because of the competition of compound. It is also an interesting commentary on the turn of the wheel of economic fortune that, while vegetable shortening in the early days found it necessary to

[1] This greater elasticity comes not only from the fact that there are a larger number of substitutes for pork than for lard, but even more from the respective places of meat and shortening in the diet. In economic terms, the utility to the individual of additional increments of shortening for personal consumption declines much more rapidly than does that for meat. In the United States, at least, it may be assumed that the level of consumption of lard and compound together is not greatly below the point of satiety for the major part of the population, taking into consideration the ingestion of fats in other forms. From this, it follows that increased supplies of lard can be disposed of only at relatively greater sacrifices in price position than would be necessary if its demand were more elastic.

make itself as much like lard in appearance and texture as possible, lard is now coming to the place where it finds it advantageous to adopt some of the characteristics of certain manufactured cooking fats.

At least two of the large packers are endeavoring to meet this competition by putting out brands of improved lard which meet the requirements of uniformity, stability, and convenience of package. These brands consist of carefully refined and deodorized lard which is also lightly hydrogenated. The treatment is designed to give lard the stability, bland flavor, and consistency of competing vegetable shortening. One of these products also contains about 5 per cent of vegetable oil. It is worth noting that they are being presented to the public as improved shortenings, and not as lard.

It is to be anticipated that this type of modified lard shortening will be produced in increasing quantities, because of a recent ruling of the Secretary of Agriculture permitting the refining of lard with caustic soda in federally inspected establishments. In consequence, it is now possible by refining to make lard a more uniform product than hitherto it has been. If such refined and deodorized lard is also hydrogenated, it can be made quite uniform.

If lard, modified by refining, deodorizing, or hydrogenation, or by all three processes combined, should come on the market in increasing volume in the future, as is easily possible, sharpened competition between lard and compound producers would result. Such lard would have many of the characteristics of vegetable shortening, the most important being uniformity and the capacity to cream well. Some of those who have been using compound because of its uniformity and lack of characteristic flavor might return to lard in this modified form, but it would be largely on the basis of price considerations. The costs of modifying lard in the manner under considera-

tion must be appreciable, so that, except under special circumstances, there seems no very great likelihood of commercial users shifting from compounds to modified lard.

The situation is quite different with the household trade. It is easily possible that modified lard may make inroads on the branded, packaged vegetable shortening trade which, like the trade in trade-marked, nationally advertised goods generally, is subject to less fluctuation based on price, and on the whole would seem to offer a more generous spread between costs and sales price. It is, therefore, not surprising that the makers of modified lard are marketing it predominantly through retail distributors to housewives in small packages under brand names. Some of it is being put out in cartons in size and shape similar to those used for margarine, rather than in tin cans, the customary container for vegetable shortening. It is possible that such cartons may be more widely used in future even for vegetable shortening and ordinary lard, for they are cheaper and apparently now more generally practicable than formerly, because of the increasing availability of mechanical refrigeration in grocery and other retail shops.

The opinion among those connected with the packing industry is not unanimous on the advisability of pursuing this method of competing with compound. It is pointed out that this treatment of lard removes all its characteristic flavor, and reduces it to an ordinary bland shortening, scarcely distinguishable from vegetable shortenings which are made of cheaper ingredients. This means that the public is being further educated away from a taste for lard, as such, and that the result will inevitably be a complete disappearance of the price differential in favor of lard, which still exists much of the time in the bulk trade.

The ruling of the Department of Agriculture to permit the refining of lard with caustic soda, made in the belief that it represents a farm-relief measure, permits the sale of a wider range of the hog's fat as lard, and thus presumably enhances the value of hogs by converting more of their fat into high-grade products. For example, it is now possible to use for modified lard so-called "salt-trimmings lard," which is lard rendered from meats trimmed off from cuts that have gone through a pickling process. While the new regulation does not contemplate that any of the fats formerly classed as inedible may now be used for edible purposes, it does permit the salvaging of certain fats and the consequent increase in the total yield of high-grade lard.

The wisdom of this measure likewise is questioned in some quarters, not only because it may encourage carelessness and unsanitary conditions in packing houses, but also because neither packer nor farmer will necessarily profit from an increase in the output of lard at a time when production appears to be in excess of what the market will take at a price to yield the producers a good profit. Some believe that it would be more profitable for the packers to throw considerable portions of lard into the grease classification, thereby reducing the supply of lard and causing its price correspondingly to stiffen. To this view, economic theory, if not public policy, lends its support.

As pointed out elsewhere, compound has developed an independent market, in considerable part, at least. If this were not so, such cooking fats would disappear from the market to a much greater extent than they did in the years when they sold at as high or at a higher price than lard. This independent market is probably composed not merely of consumers like Jews, Mohammedans, vegetarians, and those who dislike the flavor of lard, but also of

industrial users, like bakers and confectioners, who use compound in special ways to which it is better adapted than lard. These uses, of which the manufacture of products in which sugar has to be creamed with the fat is perhaps the most important, are discussed in Appendix C. It is, in part, to give lard some of the special characteristics of vegetable shortening that packers are manipulating lard in the manner above described.

CHAPTER VI

THE COMPOUND INDUSTRY AND THE NATIONAL ECONOMY

If the competition between compound and lard discussed in chapter v is in fact appreciable, it follows that the compound industry has its repercussions upon hog raisers. This is not the place to appraise the competition between the cotton belt with its cottonseed-oil output and the corn belt with its lard production. Such an appraisal would involve analysis in detail of the position of hogs in American agriculture, and this has been presented elsewhere.[1] It does, however, fall within the scope of this treatise to sketch some of the results of that competition in so far as they may be inferred from the considerations presented in preceding chapters.

The relationship of compound to lard has some analogies with the relationship that exists in Denmark between butter and margarine. The Danes export large quantities of butter and yet maintain a very high dietary consumption of fat, largely because they consume margarine in place of the butter exported. To the extent of the substitution, they as a nation draw a profit from abroad, corresponding to the difference between the cost of margarine and the sales price of butter. From the importation of oilseeds they reap other material gains, some of which have been discussed in chapter iv (p. 156); but these need not concern us here.

For many decades, the United States has produced more lard and cottonseed oil combined than it needs. It

[1] Taylor, *op. cit.*

has had the choice of two methods for the disposal of the surplus: (1) to consume most of its lard at home and send only a minor fraction abroad to be sold at relatively high prices as a food fat, while at the same time sending much of its cottonseed oil abroad to be sold at relatively low prices in competition with cheap vegetable oils; or (2) to keep most of its cottonseed oil at home for use in place of lard and, at the same time, to ship much of its lard abroad to be sold as a food fat. In other words, the choice has been between consuming the maximum possible of a product, lard, derived from a raw material, corn, while exporting the maximum of an unconverted raw material, cottonseed oil, or *vice versa.* Without conscious planning, the second course has been followed—presumably because, as in Denmark, substitution has returned a profit so far as the national economy is concerned. Pound for pound, the American profit has presumably been less than that of Denmark, because the price spread between lard and compound is much less than that between butter and margarine. Nevertheless, because the volume of lard export is so very great, the total gain has probably been very considerable.

However, there is one important difference between the Danish and the American procedure. The Danes substitute margarine, made from imported raw materials, oilseeds, for a domestic product, butter. The substitution does not involve the competition of one form of farming with another. Americans, on the contrary, substitute a wholly domestic product, cottonseed oil, for another domestic product, lard. Since each is produced by a different type of farmer, we have in the United States, as the result of the substitution, competition between two types of farming—a matter of no little political significance.

In former decades, both lard and cottonseed oil were produced in surplus and a large volume of each was ex-

ported. At present, and for some years past, exports of cottonseed oil have been so small that they can hardly be designated as a surplus. However, the production of lard and cottonseed oil combined yields a large surplus, which finds expression in larger exports of lard than of cottonseed oil. Therefore, since the two fats are substituted for one another in the domestic market, the price of each is geared to the world price. In the case of lard, the influence of the American surplus upon the world price is large, because the United States is the heaviest exporter of lard. In the case of cottonseed oil, this influence is small, because the American export of cottonseed oil is an insignificant fraction of the world supply of vegetable oils and, since 1921, has been a very small fraction of the domestic output. It follows that curtailment of American lard exports would probably have affected world lard prices more than world cottonseed-oil prices have been affected by a corresponding reduction of cottonseed-oil exports. If it is true that consuming much cottonseed oil at home in the form of compound has made possible, or necessary, heavier exports of lard, then the corn-hog farmer presumably suffered by the substitution. On the other hand, the cotton farmer has probably benefited by the substitution relatively little, because of the great volume of vegetable oils from other sources available on the world market.

But this does not mean that the nation as a whole does not benefit. Both compound and lard are vehicles for marketing crops. The conversion of corn into lard is a process that adds value exactly as any manufacturing process adds value. Similarly, the manufacture of compound adds value to cottonseed oil. While the world would take our cottonseed oil at the general price level prevailing for vegetable oils, it does not want our compound, nor does it want our corn. It is not willing to pay

us for converting cottonseed oil into compound. Therefore, we consume our cottonseed oil at home and send lard abroad. It is extremely likely, though not statistically demonstrable, that the world has been paying us more than we would have received had we exported less lard because we consumed more lard and had we exported more cottonseed oil because we consumed less compound.

However, the time may come—indeed, may be here—when, because of very large lard exports or because of European consumption shifts from lard to margarine and compound, it will no longer be advantageous to release lard for export by consuming compound. This practice will become disadvantageous whenever the world price of lard sinks so low relative to other fats and oils that the United States receives nothing from abroad for converting corn into lard, or receives less than the production costs of corn. If this time has arrived, the nation may be losing more than it gains by exporting lard and consuming cottonseed oil at home, however advantageous, viewed nationally, this practice may once have been. To appraise the situation exactly is as yet difficult, perhaps impossible. If substitution is no longer advantageous, the remedy is not easy to discern. The first measure that comes to mind is reduction of the export of lard until a new equilibrium in the world supply of fats and oils is reached, such that the returns on lard exported pay for the costs of producing corn and converting it into lard. This might be brought about in three ways: (1) by reducing lard production; (2) by increasing lard consumption at home; or (3) by both.

Reducing lard production without reducing hog products would be difficult, because lard is a joint product with pork, but it might be done by growing the leaner type of bacon hogs and marketing them at relatively light

weights. The Agricultural Adjustment Administration is now endeavoring to reduce both the hog population and the corn (maize) acreage. At this date of writing (February 1934), it seems likely that the immediate objectives of this program may be substantially achieved. However, it is possible that the corn crop may not be reduced in the same proportion as acreage, and that future corn yields per acre may be higher because of the operation of the program. Just how, over the next few years and for the more distant future, present emergency measures will affect the situation it is not possible to see.

The expansion of domestic lard consumption and the contraction of compound consumption would also be difficult. Cottonseed oil is a joint product with cotton and, therefore, cottonseed-oil production cannot be lessened without reducing the cotton crop or wasting cottonseed. It is hard to see how compound consumption can be depressed, except by artificial means, such as the encouragement of the export of cottonseed oil by export bounties or/and the hampering of compound consumption by a tax like that on colored margarine. It is to be recalled that such taxes were proposed in the bills considered by Congress about 1890 to control the industry. Tariffs also present some possibilities of influencing consumption; these have been discussed in chapter iv. It is conceivably possible by tariffs to force both cottonseed oil and lard into non-food uses.

Until the past year or so, neither legislative procedure has been proposed in recent decades; and this is perhaps due to the failure of the hog raiser to understand the situation. He cannot sell meat and lard separately; he must sell hogs composed of both. He knows in a general way that the current price of lard is reflected in the price he receives for his hogs; but lard is only a fraction of the hog and the factors affecting the price of lard are too re-

mote for him to grasp fully. That compound is one of the many factors affecting the domestic market for lard and indirectly to some extent the farm price of hogs has largely escaped his notice. He has appeared quite indifferent to the growth of the compound industry; forty years ago, when this industry was, as we have seen, the subject of a bitter controversy in Congress, he was not deeply moved.

It is, therefore, understandable why, after the legislative attempt to curb the cooking-fat industry by Congressional action failed in the 'nineties, hog raisers seem to have shown no special interest in legislation specifically directed toward favoring lard. In those days, the legislative remedies most generally in the public mind were tariffs, and through these, as has been pointed out in chapter iv, lard could hardly benefit. Tariffs, though ineffective, nevertheless were maintained at levels varying from 1 to 2 cents a pound until lard was placed on the free list in the Tariff Act of 1913. In 1922 again a duty of 1 cent was imposed and in 1930 this was raised to 3 cents. It is only in recent years, as the public mind became accustomed to other methods of assisting agriculture, that taxing compound in order to assist lard was again suggested.

Proposals for such taxation were revived three or four years ago. Bills to tax substitutes for lard were introduced in a number of state legislatures. The majority failed of passage; several were vetoed. In South Dakota alone was a law enacted on March 16, 1931, imposing a tax of five cents a pound on substitutes for lard and cooking oil, other than corn oil, and requiring dealers to pay substantial license fees. It is, perhaps, significant that South Dakota has next to the largest number of hogs relative to the population—in 1930, 4.0 for each inhabitant. Iowa, with the largest ratio, had 4.1. The declared

purpose of the South Dakota law was to collect revenue, but there can have been no serious belief on the part of many that it would achieve this purpose. It must have been obvious, if one considered the spread between cottonseed-oil and lard prices, that the tax was sufficient to make the sale of lard substitutes unprofitable most of the time, by wiping out this spread. As a matter of fact, dealers in South Dakota generally ceased to handle all cooking fat except lard. The constitutionality of the law was very soon called into question, and cottonseed-oil producers sent representation protesting this type of legislation. As a result, early in 1933 an officer of the National Cottonseed Products Association was invited to appear before a South Dakota legislative committee to present the views of his organization. This occasion was used to point out the danger to the Corn Belt of instigating retaliatory legislation, in which the North stood to lose more than the South, since the volume of foodstuff of northern origin consumed in the South is far greater than that of southern food products consumed in the North. A month after this hearing the South Dakota law was repealed, and at this time of writing there appears no further evidence of concerted efforts to discourage by taxation the sale of compound.

There is little doubt, however, that if the movement should be successfully revived, a tax on lard compound would succeed in lessening, or, if large enough, in suppressing the competition of manufactured cooking fat.[1] The consumption of lard in the United States would rise; but it is questionable whether this, by itself, would raise lard prices by anything like the amount of the tax. The primary effect would be to reduce exports, and this would

[1] A revival of anti-margarine legislation seemed under way in state legislatures in the winter of 1932–33. At least eighteen states were considering bills on the subject, and the total number of such measures introduced was well above thirty.

tend to raise world lard prices at least temporarily. Such a rise would stimulate substitution in Europe for which there is abundant opportunity. Nearly all the oils of the world could be drawn upon, and their supply available in Europe would tend to be increased by the considerable fraction of the cottonseed-oil production of the United States that might again have to be exported. The American lard producer might receive slightly more for his domestically consumed lard; the American consumer might have to pay slightly more for lard; the seller of cottonseed would undoubtedly receive less for his cottonseed; an important industry—that of manufacturing cooking fats—would be strangled; American consumers of salad oil, salad dressings, and margarine would probably pay considerably less for these products in the aggregate; Europe would get cheaper cottonseed oil; the American lard exporter might or might not get slightly higher prices for lard. Whether the benefits to the United States, such as they might prove to be, would outweigh the evils is a matter of opinion, not a matter statistically or otherwise demonstrable in advance of making the experiment.

If legislation of this kind should become popular among the states, the net result would be, unless Congress intervened by constitutional amendment or otherwise, tantamount to erection of tariff barriers between the states—in fact, if not in name, a balkanization of the United States that is unthinkable.

In short, so far as competition from compound is concerned, the writers see little prospect of improving the position of the hog raiser by legislative action. How far his position may be remedied by other means is a field of inquiry that lies outside the scope of this treatise, which is concerned primarily with compound as an industry important in its own right, especially in the Southern

states, and only incidentally with compound as it affects lard.

As this book goes to press the first cotton crop to be affected by the Agricultural Adjustment Act has been marketed and steps have been taken to limit the production of hogs. That the operations under this act so far as hogs are concerned seem to be successful has been indicated above. Success has also been achieved in reducing cotton acreage. That the crop was nevertheless about as large as the moderate-sized crop of last year is due apparently to favorable growing conditions. Should weather be less favorable next year, probably quite a short crop would result and comparatively little seed would be available for crushing. In so far as operations under this act succeed in reducing output of these farm products, changes in the status of the two principal cooking fats on the American market will result. As regards lard, any appreciable reduction in hog raising will undoubtedly result in greater or less decline in lard output, depending on the type of hog grown and the method of marketing the several parts of the animal. Whether this decline will be reflected in a corresponding drop in amounts of lard retained for domestic consumption is another question. Any stiffening of prices, which is the basic object of the act, would tend to curtail exports, with probable results such as have been considered above in connection with the discussion of a tax on compound. It may be that the chief ultimate effect of the act so far as lard is concerned would be the loss of additional portions of the foreign market, without affecting greatly the level of domestic lard consumption.

The output of compound, unlike that of lard, will not necessarily be curtailed by operations under the act, since other fats may be drawn upon to provide raw materials for the industry. There are a number of domestic materials available which are not subject to control under the

act. In addition, for reasons already mentioned (p. 134), foreign oils may likewise be more heavily employed, at least for a time. Judging the future by the past, however, it is not rash to predict that such an increase in imports would be very promptly followed by an urgent campaign to increase vegetable-oil duties. If the act remains long in force this is almost certain to happen, since some farm groups, including the ever-alert dairy interests, have continued since 1930 to work for a change in the present tariff law so as to include all foreign fats and oils on the duty list, whether edible or inedible.

Clearly, so far-reaching a legislative innovation, even though designed as an emergency measure, is likely to exert both direct and indirect influence on the compound industry, as on industries more prominently in the public eye. Its effects may well last beyond the period of its operation, through altering agricultural practices in the South, for example. But what these effects will ultimately be it is idle now to prophesy. The future is obscured by too many politico-economic unknowns.

APPENDIX

APPENDIX A

GLOSSARY

Annatto A yellowish-red dye obtained from the pulp inclosing the seeds of the arnatto tree of Central America. It has been widely used to color butter and margarine, but is now in part replaced in this use by anilin dyes.

Bleaching See Appendix B, pp. 253 ff.

Camphene A popular term, formerly applied to essential resinous oils, such as the purified or distilled spirits of turpentine.

Catalyst A substance which alters the rate of a reaction without itself becoming permanently changed. Its action is known as catalysis. Commonly the rate of reaction is accelerated, but retardation is also possible.

Caustic soda A compound of one atom each of the metal sodium and the gases oxygen and hydrogen. Its formula is $NaOH$; its proper scientific name is sodium hydroxid. It is also known as soda lye, or simply as lye. It is very alkalin and corrosive.

Coconut oil The fat obtained from the meats of the coconut, the seed of the coconut palm, *Cocos nucifera* L. Commercially, the fat is not obtained from fresh nuts, but by pressing (*q.v.*) copra, as the dried meats are termed. However, natives in the tropics often prepare the oil in the household from fresh meats. The meats are grated into water, the suspension heated, and the oil skimmed off. Such oil is of superior quality but is not a factor in world trade. Coconut oil has a melting-point of 23°–27° C.; it is, therefore, solid in temperate climates.

Colza oil A term formerly applied to oil expressed from fine French seed of *Brassica napus;* as now used, it is practically synonymous with rape oil.

Cottonseed oil The oil expressed from the seed of different species of the cotton plant (*Gossypium*). The seeds of the Egyptian, Sea Island, Jamaican, and Brazilian sorts are hairless or naked after the removal of the fiber, but other varieties re-

main covered with a fine fuzz or lint. In preparing oil from the naked varieties, the seed is crushed or ground, heated, and the oil expressed in hydraulic presses. Other varieties are first delinted and decorticated in special machines before they are ground, cooked, and pressed. The oil (crude oil) as it runs from the presses is deeply colored, red to almost black.

Cottonseed-oil stearin The stearin obtained in winterizing (*q.v.*) cottonseed oil.

Crushing (of oilseeds, also known as pressing). A process for separating oils from solids with which they are mixed. It is the method used in the production of vegetable oils from oilseeds; it is the counterpart of rendering (*q.v.*), the method used in producing animal fats. Briefly, the method is as follows: The seeds are cracked, shelled, or hulled (i.e., decorticated), when this is necessary. They are then crushed or ground. The ground material is then subjected to pressure, either cold or hot. If no heat is used, the oil is known as cold-pressed oil. If pressed hot, the seeds are cooked, usually with steam, before being subjected to pressure. The expression of the oil is practiced either with hydraulic, screw, or wedge presses, or with special machines known as expellers. These are built on the same principle as the ordinary meat-chopper or sausage machine, which nowadays is to be found in most kitchens. The oil-bearing material is fed into one end of a cylinder within which a power-driven worm conveyor forces the material to the other end of the cylinder and out against resistance, exactly as though it were sausage meat. The pressure exerted in the process squeezes out the oil.

The residue left after the expression of the oil, whether this has been done in a press or in an expeller, is known as oil cake, press cake, pressed cake, or simply as cake. It is used for feed or fertilizer.

Pressing in presses is also employed to some extent in rendering animal fats. After heating the tissues and removing the melted fat, the residue is sometimes subjected to pressure to recover the melted fat that is retained in the material.

Pressing is also employed in the manufacture of oleo oil, stearin, tallow oil, grease oil, and lard oil. The process is described in some detail in Appendix B, pp. 235 ff.

Decolorizing See Appendix B, pp. 253 ff.

Deodorizing See Appendix B, pp. 258 ff.

Diglycerid A substance formed by the chemical union of two

molecules of fatty acids with one molecule of glycerin, two molecules of water being eliminated in the process.

Drying oil An oil that absorbs oxygen readily. When exposed to the atmosphere in a thin film, these oils are gradually converted into a solid elastic waterproof resin; it is this property of forming tough films that causes drying oils to be used in paints and varnishes.

Edible tallow Choice tallow (*q.v.*) fit for food. See also *Oleo stock.*

Ester A substance formed by the chemical union of an alcohol, for example ordinary alcohol or glycerin, with an acid, water being eliminated in the process. Glycerids are, therefore, esters.

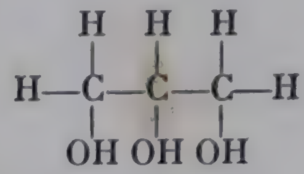
Fatty acids A term originally applied to the acids separated chemically from fats and oils. The term is now applied by chemists to any organic acid in which the carbon atoms are linked together without ring formation.

Filter press A device to separate a solid from a liquid in which it is suspended. In its most usual form, it is an assemblage of square screens of canvas all of the same size. They are placed on a horizontal rack like books on a shelf. Thus, a series of thin, flat compartments is formed, very much as though one were to stack upright along a shelf a series of ordinary square window screens, in which the wire netting had been replaced by canvas. The canvas is usually backed by a corrugated metal plate, so that it will not burst under pressure. In the filter press, the frames are pressed so tightly together by means of a powerful screw that liquid cannot escape between them. The frames of the screens are perforated with a set of holes placed so as to form a continuous tube reaching from one end of the stack to the other when the screens are assembled. This tube opens into every other compartment. Through this tube, the liquid is pumped into these compartments and forced through their canvas walls into the adjacent compartments, which do not communicate with the tube. The canvas holds back the fuller's earth or other suspended material and permits only clear oil to ooze into the adjacent compartments. The latter are provided with channels which permit the clear oil to escape to the outside, where it runs into storage tanks.

Foots See *Refining.*

Fuller's earth See Appendix B, p. 255.

Glycerin A white, somewhat viscous, sweet liquid. Chemically, it is an alcohol and has the formula, $C_3H_8O_3$, which is represented graphically thus:



It is found in fats and oils in which it is combined with fatty acids. It is obtained commercially as a by-product in the manufacture of soap. See also *Stearin, Saponification.*

Graining See Appendix B, p. 235.

Grease Any fat of a soft-solid consistency which, for any reason, is regarded as inedible. In packing-house parlance, grease is merely inedible lard.

Grease oil The oil obtained in manufacturing stearin from grease by pressing.

Hydrogenation See Appendix B, pp. 264 ff.

Iodin number The percentage by weight of iodin absorbed by a fat in the natural state. It is an index to the degree of unsaturation of a fat. See also *Unsaturated fatty acids.*

Lard (French, *saindoux, graisse de porc;* German, *Schweinefett, Schmalz;* Italian, *strútto, lárdo, grásso di pòrco*). Originally, the fat rendered from the leaf of the pig, i.e. the fat from the kidneys and bowels. For some decades, however, it has meant in America the fat taken from any and every part of the hog; and is so recognized in the regulations for the enforcement of the United States Meat Inspection Act.

Lard oil An oil obtained in preparing stearin from lard by pressing (*q.v.*) by the method described in Appendix B, p. 235.

Lard stearin Stearin prepared from lard by pressing.

Leaf fat The fat from the omentum or leaf of animals. The omentum is a sheet of tissue attached to the stomach and intestines. The ruffle (kidney) fat is also usually included with that from the leaf.

Linseed oil Flaxseed oil. The oil obtained from flaxseed, *Linum usitatissimum.* It is a drying oil.

Margarine A butter substitute. It is made by emulsifying in milk, whole or skim, bland, flavorless, odorless fats mixed in such proportions as to have a melting-point of about 26° to 27.5° C.,

inoculating this emulsion with cultures of certain milk-souring bacteria in order to impart the flavor of butter, and then, by rapid chilling, separating the fat from the excess of liquid in which it is emulsified. This solid-fat emulsion is then worked and handled like butter. The most important fats employed in its manufacture are neutral lard, oleo stock, oleo oil, coconut oil, palm kernel oil, peanut oil, oleostearin, lard stearin, cottonseed oil, and sesame oil.

Mixed glycerid A glycerid (see also *Triglycerid*) which contains in its molecule more than one kind of fatty acid.

Monoglycerid A substance formed by the chemical union of one molecule of a fatty acid (*q.v.*) with one molecule of glycerin, one molecule of water being eliminated in the process.

Neutral lard See chapter i, p. 10.

Oil cake See *Crushing*.

Oleic acid An acid forming a component of certain triglycerids (see *Olein*). It is a liquid, and has the formula $CH_3(CH_2)_{14}(CH)_2COOH$, or $C_{18}H_{34}O_2$. It will be noted that it has the same formula as stearic acid (*q.v.*), except that it contains two atoms less of hydrogen. It is, therefore, an unsaturated acid (*q.v.*).

Olein A common constituent of fats and oils. It is a triglycerid, like stearin (*q.v.*), but differs from it in that it contains three molecules of oleic acid (*q.v.*), instead of stearic acid. It is a viscous liquid, congealing to a solid at a temperature of 4° to 5° C., i.e. a temperature a little above the freezing-point of water.

Oleomargarine In America, the statutory designation for margarine and all other butter substitutes. In the trade, the term is sometimes used to designate margarine (*q.v.*) containing animal fats to distinguish this type of butter substitute from margarine consisting wholly of vegetable oils. Originally, in France, the term was used to designate the fat now known in America as oleo oil (*q.v.*).

Oleo oil See chapter i, p. 11.

Oleostearin A solid fat obtained from oleo stock (*q.v.*) as a by-product in the manufacture of oleo oil (*q.v.*). The method of manufacture is described in Appendix B, p. 235. Its composition and properties vary with the method of preparation. Most commonly, it has a melting-point of 50° to 54° C.

Oleo stock A choice grade of edible tallow made by chilling caul and ruffle fats and the fats obtained from trimming the viscera immediately after slaughter, then hashing them, and rendering with water at low temperatures not exceeding 76° to 77° C. Sometimes the best grades of cutting fats from the cutting and boning operations are also used. In Europe, it is also known as *premier jus*. It is the counterpart of neutral lard (*q.v.*). It is used primarily for the manufacture of oleo oil (*q.v.*).

Organic compound Any substance, the molecules of which contain carbon.

Palmitic acid An acid forming a component of certain triglycerids (see also *Palmitin*). It forms tufts of fine crystalline needles, melting at 62.6° C. Its chemical formula is $CH_3(CH_2)_{14}COOH$, or $C_{16}H_{32}O_2$.

Palmitin A common constituent of fats and oils. It is a triglycerid, like stearin (*q.v.*), but differs from it in that it contains three molecules of palmitic acid (*q.v.*), instead of stearic acid. It is softer than stearin and melts at 63° to 65° C.

Palm kernel oil The fat obtained from the seeds of the oil palm (see *Palm oil*). The seeds or kernels are cracked and the fat is expressed from the meats. Palm kernel oil closely resembles coconut oil. Its melting-point is 23° to 30° C.; it is solid like coconut oil in temperate climates.

Palm oil The oil obtained from the flesh of the fruit of the oil palm *Elaeis guineënsis*, a native of West Africa. It should not be confused with palm kernel oil, obtained from the hard seeds, inclosed within the flesh of the same fruit. Palm oil is orange-colored. It is imported principally from West Africa, but a smaller volume of very pure oil is now also exported from Sumatra, where the palm has been introduced by planters. Palm oil is used in soap, in foodstuffs, and in the manufacture of tin plate to prevent oxidation of the sheets during the process of tinning.

Pearl ash A term formerly applied to commercial potassium hydroxid or caustic potash, KOH (see also *Potassium hydroxid*). It was made by leaching wood ashes with water, boiling off the water, and causticizing the residue.

Potassium hydroxid Caustic potash. It is a compound of one atom each of the soft white metal, potassium, and the gases, oxygen and hydrogen. Its formula is, therefore, KOH. It is very alkalin and corrosive.

Pressing See *Crushing*.

Rape oil The oil obtained from the seed of various members of the mustard family, principally *Brassica campestris*, L.

Red oil The commercial name of an impure oleic acid, obtained as a by-product in the manufacture of stearic acid. It is extensively used, combined with alkali, as a detergent in the textile trade and also as a soap material.

Refining (See also Appendix B, p. 251). The removal of free fatty acids and other objectionable substances—principally nitrogenous and mucilaginous matters from oils and foots. The oil or melted fat is treated with a little more than the requisite amount of strong aqueous caustic soda (*q.v.*) solution to convert the free fatty acid present into soap. The oil and the alkali solution are thoroughly stirred together and sometimes warmed. The mixture is then allowed to separate. The result is that the oil, freed from fatty acid, floats on top of a layer of soap-alkali solution and other impurities which are drawn off. The oil is then washed with water to remove soap, alkali, and other impurities, when it is ready for the decolorizing or deodorizing process. There are other methods of refining, but this is the one most commonly used in America. The under layer of soap and other impurities, which is drawn off from the oil, consists of solid matter mixed with some alkalin water. It is known as foots, probably because it collects at the foot of the tank. It is used to manufacture soap or washing powder.

Rendering The process of separating fats or oils from animal tissues by heating dry or in the presence of moisture. See Appendix B, pp. 244 ff.

Saponification The chemical process by which a triglycerid (see also *Stearin*) is split into its components, glycerin and fatty acid. In the process, three molecules of water are taken up. The process of splitting a substance whereby water is taken up is known to chemists as hydrolysis, a word which is the Greek for cleavage by water. It was first observed to take place in the manufacture of soap. The term saponification (instead of the more exact term hydrolysis) is, however, applied indiscriminately and inappropriately to any chemical change of this nature, whether or not soap is formed.

Sesame oil The oil obtained from the seeds of *Sesamum indicum* and *Sesamum orientale*.

Shortening Any fat used in making baked products to modify the texture so as to render such products more tender, crumbly, or flaky. See also Appendix C.

Simple glycerid A glycerid (see also *Triglycerid*) which contains in its molecules only one kind of fatty acid.

Soap A combination of a fatty acid with a metal, i.e. a salt of a fatty acid.

Sperm oil Oil obtained from the head cavities and blubber of the sperm whale. See also *Spermaceti.*

Spermaceti A kind of animal wax from the head of the sperm whale (French, *cachelot;* German, *Pottfisch*), particularly *Physter macrocephalus.*

Steam lard Lard rendered with steam under pressure. See also Appendix B, pp. 244 ff.

Stearic acid An acid forming a component of the molecule of certain triglycerids (see also *Stearin*). It is a hard, white solid with crystalline fracture. Its chemical formula is $CH_3(CH_2)_{16}COOH$, or $C_{18}H_{36}O_2$. The stearic acid of commerce is never the pure acid; it is a mixture of stearic with other acids, such as palmitic acid. See also *Palmitin.*

Stearin A common constituent of fats and oils. It is the triglycerid of stearic acid, i.e. it is formed by the chemical union of one molecule of glycerin with three molecules of stearic acid, three molecules of water being eliminated in the process. Its formula may be represented schematically thus:

$$
\begin{array}{lll}
 & \mathrm{H} & \\
 & | & \\
\mathrm{H}- & \mathrm{C}-\mathrm{O}-\mathrm{O}-\mathrm{C(CH_2)_{16}CH_3} & \text{(stearic-acid radical)} \\
 & | & \\
\mathrm{H}- & \mathrm{C}-\mathrm{O}-\mathrm{O}-\mathrm{C(CH_2)_{16}CH_3} & \text{(stearic-acid radical)} \\
 & | & \\
\mathrm{H}- & \mathrm{C}-\mathrm{O}-\mathrm{O}-\mathrm{C(CH_2)_{16}CH_3} & \text{(stearic-acid radical)} \\
 & | & \\
 & \mathrm{H} & \\
\end{array}
$$

(glycerin radical)

It is not known to occur in the pure form in nature and is always associated with other triglycerids in fats and oils. It is extremely difficult to separate completely from associated triglycerids. The stearin, so-called, of commerce is always a mixture of stearin with a certain amount of other triglycerids. Pure stearin is a white, crystalline solid, greasy to the touch, and practically tasteless and odorless. It melts ordinarily at about 72° C.

Stearin from cottonseed oil Stearin obtained from cottonseed oil in winterizing (*q.v.*).

Tallow (French, *suif;* German, *Talg*). The fat obtained from cattle, sheep, and goats. It is solid at ordinary temperatures, its melting-point ranging from about 43° C. to about 54° C.

Tallow oil The more liquid portion of tallow obtained in producing stearin by pressing (*q.v.*).

Tallow stearin The stearin (*q.v.*) made from tallow by pressing.

Triglycerids See *Stearin.*

Unsaturated compound See *Unsaturated fatty acid.*

Unsaturated fatty acid A fatty acid (*q.v.*), the molecule of which contains less than the maximum of hydrogen possible. It is unsaturated with respect to hydrogen. The term unsaturated is applied to any organic compound exhibiting this characteristic. Oleic acid (*q.v.*) is such an unsaturated acid. Most unsaturated fatty acids are liquids at ordinary temperatures. By chemical means, these acids may be made to take up (i.e. combine with) hydrogen. This process is known as hydrogenation. It converts a more unsaturated fatty acid into a less unsaturated one; or, if the hydrogenation is carried to completion, into a saturated fatty acid, i.e. into one which contains the maximum possible of hydrogen. Saturated fatty acids are usually solid. Thus by hydrogenation, oleic acid, a liquid, is converted into the saturated acid, stearic acid, a solid. Similarly, linoleic ($C_{16}H_{28}O_2$) and linolenic acids, which are more unsaturated, are first converted into oleic and finally into stearic acid.

Winterizing (also known as demargarinating) A process to which oil is subjected to prevent it from congealing in cold weather or depositing stearin when chilled. It consists in slowly cooling the oil and filtering off the stearin that separates. Such an oil is known as a winter oil. Conversely, an oil that has not been winterized is known as a summer oil.

APPENDIX B

THE HISTORY OF THE TECHNOLOGY OF THE COMPOUND INDUSTRY

Introduction

In the main body of the text reference has been made to the effects of technological developments upon the economic evolution of the compound industry, but neither the details of processes nor their history have been presented there. To have included either in the main body of the text would have entailed many digressions and disturbed the orderly presentation of the economic evolution of the industry. Yet the history of the technology employed is an essential part of the history of the industry. It is, therefore, presented in this appendix where it may be examined by those interested in the history of the application of science and invention to industry rather than in the history of the economic factors that served to shape this particular industry.

It has been pointed out (p. 5) that, in cookery, consistency of oleaginous material is important only when it is to be used for shortening. For technical purposes, on the contrary, consistency may be the factor that determines the choice of a particular fat or oil. To be burned in lamps in winter, for example, or to be used in the ancient practice of dressing wool, the fat must be fluid. In candles, the fat must be as hard as possible. Early progress in producing and refining fats and oils was stimulated by technological requirements, such as these, rather than by demand for food purposes. The most active period of progress in this field began with the end of the eighteenth century and continued into the middle of the nineteenth century. This was due in part to the fact that in this period the science of chemistry developed and with it the application of science to many industries became possible for the first time. An even more important stimulus was the growing demand for fats and oils in general, which has been discussed in the main body of the text (chapter v). Many factors were active toward the end of the eighteenth century to encourage progress in fats and oils technology. The most important forward steps were taken in the manufacture of soap, lubricants, cloth, and leather, and in illumination. Discoveries made in these industries were utilized in later times in the manufacture of food fats when such manufacture became neces-

sary. The processes developed in connection with illumination ultimately became especially important for the food-fat industries. Therefore, to search out the origins of the technical processes of these industries it is necessary to inquire into the history of the production of hard fats for candle making, of the production of permanently fluid oils for lamps, of the refining of oils, of the deodorizing of illuminating oils, and of the methods of bleaching fats, especially for candle making.

The Production of Hard Fats

Originally, candles were made of beeswax or tallow. In the thirteenth century, they were still considered a luxury.[1] Spermaceti began to be used only in the first half of the eighteenth century.[2] It was known in medieval Europe, but was used as a medicine, records of such use going back at least as far as 1471.[3] It was obviously a rare and precious substance, and any such substance in those days was liable to be put to medicinal use. According to Goode,[4] sperm whales were not often taken before 1720–30 because they were too fierce. Spermaceti remained comparatively scarce even after commercial whale fishing had developed, because the sperm whale is a denizen of tropical and subtropical seas, though it does range into colder waters. Scammon[5] states that specimens have been taken as far south as latitude 56° and in the Pacific as far north as 56° 12′. It is, however, not one of the commoner species of northern waters; hence in the early days it could not have been taken frequently. Spermaceti was, therefore, not a cheap material. It became relatively so only after the southern fishery was begun by British colonists in America in the second decade of the eighteenth century,[6] for only then were sperm whales taken regularly and in numbers.

[1] According to J. Lewkowitsch (*Chemical Technology and Analysis of Oils, Fats, and Waxes* [London, Macmillan, 1922, 3 vols., 6th edition], III, 262), "the Dominican monk Flamma reports, in the beginning of the thirteenth century tallow candles were still considered a luxury."

[2] Chamber's *Cyclopedia* in 1738 stated that "Spermaceti candles are of modern manufacture, ... superior to the finest wax candles." Quoted in *A New English Dictionary . . . .*, edited by J. A. H. Murray, *et al.* (Oxford, Clarendon Press, 10 vols., 1919), Vol. IX, Part 1, p. 578; K. Kamarsch, *Geschichte der Technologie seit Mitte des Achtzehnten Jahrhunderts* (Munich, R. Oldenbourg, 1872), p. 843.

[3] Murray, *et al., loc. cit.*

[4] G. B. Goode, *et al., The Fisheries and Fishery Industries of the United States* (Washington, Government Printing Office, 1884–87), Section V, II, 64.

[5] C. M. Scammon, *The Marine Mammals of the North-Western Coast of North America together with an Account of the American Whale-Fishery* (San Francisco, John H. Carmany & Co., 1874), p. 77.

[6] W. S. Tower, *A History of the American Whale Fishery* (Philadelphia, Publications of the University of Pennsylvania, 1907), p. 100.

Just when sperm candles were first made in the American colonies of Great Britain it is impossible to say. In the report made in 1730–31 by the Board of Trade and Plantations to the British House of Commons "with respect to laws made, manufactures set up, or trade carried on in the Colonies, detrimental to the trade, navigation, or manufactures of Great Britain," no mention seems to be made of candle manufacture.[1] However, sperm-candle making must have become established rapidly, for as early as 1748 spermaceti candles were advertised in the *Boston Gazette*[2] as though they were newly introduced. Franklin,[3] in 1758, mentions an extinguisher "for spermaceti candles only." By 1760 there were eight sperm-candle factories in New England and one in Philadelphia.[4] By 1770 the export of sperm candles alone amounted to nearly 380,000 pounds, valued at over £23,500.[5]

Toward the end of the eighteenth century, the demand for candles better than those made of tallow but cheaper than those made from beeswax[6] or spermaceti became great enough to stimulate the search for substitutes.

The earliest process used to furnish hard fats as substitutes for beeswax and spermaceti is a mechanical one. It depends upon the fact that tallow, like most other fats and oils, is a mere physical mixture of closely related chemical individuals known as triglycerids. The most important of these are stearin, palmitin, and olein. At ordinary temperatures, stearin is a fairly hard, white solid; palmitin, a softer solid; and olein, a liquid. The fats of common domesticated animals consist predominantly of mixtures of these three, and their proportions determine the consistency. If stearin predominates, the fat is hard, like tallow; if olein predominates, it is soft and oily, like chicken fat.

[1] Cf. Timothy Pitkin, *A Statistical View of the Commerce of the United States of America* . . . . (New York, James Eastburn & Co., 2d edition), 4 ff.

[2] G. F. Dow, *The Arts and Crafts in New England, 1704–1775; Gleanings from Boston Newspapers* . . . . (Topsfield, Mass., Wayside Press, 1927).

[3] *The Life and Writings of Benjamin Franklin,* edited by A. H. Smyth (New York, Macmillan, 10 vols., 1905), III, 433.

[4] Tower, *op. cit.*, 111.

[5] Pitkin, *op. cit.*, 21.

[6] Before the middle of the nineteenth century, beeswax had been displaced almost completely in the United States as a candle-making material, except for sacramental purposes, though, as late as 1816, over 7,000 pounds of wax were still exported, and though beeswax continued to be exported for a long time. No beeswax candles were manufactured in this country, and those imported from France cost 100 per cent more than stearic-acid candles. Cf. Campbell Morfit, *Chemistry Applied to the Manufacture of Soap and Candles* . . . . (Philadelphia, Carey and Hart, 1847), p. 478; also the review of this book in the *Journal of the Franklin Institute,* February 1848, Third series, XV, 122.

If stearin or palmitin be melted and then cooled, and the temperature at which the liquid congeals be noted, it is found that stearin congeals at a considerably higher temperature than palmitin and that both have set to solids at temperatures much higher than that at which olein solidifies. Furthermore, as would be expected, if a mixture of the three is melted and then slowly cooled, it is observed that first most of the stearin congeals out of the mixture, most of the palmitin and olein remaining in liquid form. The solidified stearin can be separated by merely straining and draining, if precautions are taken not to let the mass cool off further. It is a procedure exactly similar to the freezing of water out of hard cider in order to make the cider more alcoholic than it naturally is. If a barrel of cider is exposed outdoors in winter, everyone knows it is the water that congeals, not the alcohol. This is because water congeals at a much higher temperature than alcohol. Thus, it is possible to freeze or congeal out much of the water and to drain off the rest, which, therefore, contains the alcohol in more concentrated form than in the original hard cider.

Because stearin, and also palmitin, congeal at a higher temperature than olein, it is possible to perform a similar separation exactly analogous to the well-known concentration of the alcohol content of cider by freezing. The fat is melted and allowed to cool slowly to the temperature at which most of the stearin and a certain amount of palmitin congeal. The mass is then held at this temperature because the stearin congeals slowly just as the ice in cider congeals slowly. This part of the process is known as "graining," because the mass gradually becomes granular, owing to the particles of separating stearin which are suspended in the still-liquid portion. If the amount of stearin in the fat is large, the whole mass may become a soft, buttery solid.

When as much stearin has congealed out as it is desired to let separate, the still-liquid portion is drained off, care being taken not to let the mass cool further before draining is complete. As mere draining leaves a good deal of liquid adhering mechanically to the stearin, it is common practice to make the separation more complete by pressing, in order to squeeze out the liquid fraction more perfectly than is accomplished by mere draining. Hence, the process here described is often known as pressing, though pressing is not the essential feature.

By this really simple mechanical procedure, it is possible to separate most fats into one fraction much harder than the original fat and another much softer. The consistency of the two fractions depends upon the nature of the original fat, the manner in which graining is done, and the degree of pressure applied. Stearin

made commercially in this way is never the pure substance the chemist knows as stearin. It is always a mixture, chemically speaking, of stearin with more or less palmitin and small amounts of olein. The perfect separation of these substances one from the other is so difficult that it is troublesome even in the laboratory.

The earliest record the writers have been able to find of the use of this method for the separation of a solid fat into a liquid and a solid fraction is the method attributed to Blondeau[1] about the middle of the eighteenth century. Slaughterhouse offal was rendered with much water at a low temperature, while the fat was skimmed off and treated with boiling water for twenty-four hours. The fat was again skimmed off and put in a kettle with water just warm enough to prevent the fat from wholly congealing. The portion of the fat that congealed settled out. Oil of different thickness was drawn off through three cocks, one above the other in the side of the kettle. The oil was used in currying leather. It is highly probable that the separation of soft or buttery fat into a solid and a liquid fraction had been known before Blondeau's time. Spermaceti must have been prepared in some such fashion, and in French colonial Louisiana bear oil was produced in this way.[2] There is no record that pressure was used by Blondeau, but since the pressing of oilseeds was a well-known practice, it is not unlikely that Blondeau's process may soon have been perfected by the application of pressure to the solid fraction. Morfit[3] states that Bolts made candles from pressed tallow in 1799, but the patent issued to him is not clear on this point.[4] It would seem that he cooled the melted tallow under pressure without expressing any oil.

[1] Le François de la Lande, "Art du Corroyeur" (Paris, 1767), p. 19. In *Descriptions des arts et métiers, faites ou approuvées par Messieurs de L'Académie Royale des Sciences* (Paris, Desaint & Saillant). (Publication of this series began in 1761; the individual monographs are not numbered but merely dated, have no separate title pages, and are not assigned to volumes.)

[2] J. Lippincott, "Industry among the French in the Illinois Country," *Journal of Political Economy*, February 1910, XVIII, 114.

[3] Campbell Morfit, *A Treatise on Chemistry Applied to the Making of Soap and Candles* (Philadelphia, Henry Carey Baird, new edition, 1860), p. 290. This is a later edition of the work previously cited (p. 231). There was another edition, not accessible to the writers, *A Treatise on Chemistry Applied to the Manufacture of Soap and Candles . . . .* (Philadelphia, Parry & McMillan, new edition, 1856). At the time of the 1856 edition, Morfit was "Professor of Analytic and Applied Chemistry at the University of Maryland in Baltimore."

[4] *The Repertory of Arts and Manufactures: Consisting of Original Communications, Specifications of Patent Inventions, and Selections of Useful Practical Papers from the Transactions of the Philosophical Societies of All Nations*, 1800, XII, 368.

While the separation of fats into a fraction harder and a fraction softer than the original fat began to be practiced some time in the eighteenth century or even earlier, very little was then known concerning the chemistry of fats. It was not clearly understood that they are physical mixtures of different chemical substances of varying properties. Braconnot was the first to show that fats, whatever their consistency, are composed of both a solid and a liquid fraction.[1] This, he demonstrated by pressing the fat between sheets of brown paper. The paper absorbed the oil which was thereupon recovered by wetting with warm water and subjecting the paper pulp resulting to the action of a press. These experiments are perhaps the first cases of "capillary analysis" to be found recorded in the literature. In this manner, Braconnot fractionated butter, lard, beef marrow, mutton marrow, and goose, duck, and turkey fat. He also showed that oils like olive, almond, and colza oil, if sufficiently chilled, may be fractionated similarly, and he quotes Professor Gottling as having made a similar demonstration for linseed oil. Lard, when subjected to the brown-paper treatment, produced a hard fraction of the consistency of soft wax, because it retained a certain amount of the liquid fraction. To secure more complete removal of the fluid fraction, Braconnot melted lard that had been pressed once between brown paper with oil of turpentine, cooled it, and again compressed it in brown paper. In 1818, Braconnot and Simonin received a patent for what appears to be the first commercial process of pressing tallow. Tallow, mixed with turpentine or other volatile oil, was placed in a perforated round vessel lined with felt, and gradual pressure was applied. The solid residue remaining on the felt was boiled with water to drive off the turpentine or volatile oil; then heated with fresh powdered boneblack and filtered. It was too brittle to use for candles, but could be so used if mixed with one-fifth its weight of beeswax. The oil obtained was fit for soap.[2] The writers have not been able to determine whether the process was used commercially.

[1] H. Braconnot, "Sur la nature des corps gras," *Annales de chimie,* March 1815, 2 Sér., XCIII, 225.

[2] The patent record reads: 940, July 29, 1818. "Brevet d'Invention de Cinq Ans, Pour la fabrication en grand d'une matière analogue à la cire, appelée *ciromimème,* et propre à faire des bougies, des savons et du sulfate de potasse, Aux sieurs Braconnot et Simonin," *Description des machines et procédés spécifiés dans les brevets d'invention, de perfectionnement et d'importations, dont la durée est expirée;* Publiée d'après les ordres de Son Excellence le Ministre de l'Intérieur Par M. Christian, Directeur du Conservatoire Royal des Arts et Métiers (Paris, Huzard, 1825), X, 361.

See also *Bulletin de la Société pour l'encouragement de l'industrie nationale,* January 1826, X, 16, and *Dinglers polytechnisches Journal,* 1826, XX, 310.

In 1821 Dr. Claude Anthelme Manjot was commended by the Société pour l'Encouragement de l'Industrie Nationale for his candles, because he had found means to purify, to harden, and to bleach tallow and make candles from it. A factory was established about that time. By 1826, Manjot had sold his patents and his factory at Monceau near Paris to Hebert.[1] Manjot's price for candles in 1821 had been 22 sous a pound; Hebert's, in 1826, was 19 sous.

Manjot apparently held the view recently disproved by Chevreul that the elements of flesh were directly converted into adipocere, and he believed that all that is necessary to convert muscle substance into fat is to remove the nitrogen. This he endeavored to do by chemical means. He rendered adipose tissue with a mixture of dilute sulfuric and nitric acid by which method he obtained better yields and a lighter-colored product. The tallow thus rendered was then treated with a mixture of stronger sulfuric and nitric acid or hydrochloric and nitric acid, together with alcohol. A second method was to treat with sulfuric acid and oxide of manganese and at the same time pass oxygen through the molten mass.[2] The first treatment undoubtedly hardened the tallow.

A year later, in 1821, a French patent was granted to Samuel Pugh of Rouen for the use of dilute sulfuric and nitric acids in rendering tallow, whereby evil odors were avoided and a harder and whiter product obtained.[3]

J. L. Cambacérès,[4] in his patent (*brevet*) of February 10, 1825, of which more hereafter, described a commercially practical method of pressing in a hydraulic or in an ordinary press, the novel point of which was that the fatty matter was warmed before pressing to a temperature adjusted to the proportion of oily material it was desired to express. The more oil it was intended to remove, the higher the temperature.[5]

[1] *Bulletin de la Société pour l'encouragement de l'industrie nationale*, October 1826, p. 311; quoted in detail in *Dinglers polytechnisches Journal*, 1827, XXIII, 126.

[2] No. 2746, March 1, 1820. *Brevets d'invention* ... (1836), XXIX, 203.

[3] No. 1960, December 5, 1821. *Ibid.* (1832), XXII, 253.

[4] J. L. Cambacérès, an engineer, was the originator of many improvements in candle making. The writers have been unable to find a biographical sketch of him. They have encountered no evidence that he was related to Jean Jacques Régis de Cambacérès, Duke of Parma. Malepeyre describes him as "ingénieur des ponts-et-chaussées."

[5] F. Malepeyre, *Nouveau Manuel complet de la fabrication des acides gras concrets employés dans les arts, et de celles des bougies stéariques margariques, élaidiques, palmitiques et cociniques, comprenant aussi la fabrication de la stéarine, de la margarine, de la élaïdine, de la palmitine et de la cocinine, ainsi*

In 1826, Nicholas Hogesippe Manicler received an English patent for a new method of preparing fats and using them in illumination.[1] Fats were rendered with water in tight kettles under a pressure of 15 pounds per square inch. The fat, separated from the water, was spread at a temperature of 90°–100° F. on wool cloth or felt. The edges were turned in and the cloths stacked alternately with iron plates. The pile was weighted and the room kept at 90°–100° F. After most of the oil was thus expressed, the residue was further pressed at 80°–90° F. in a hydraulic press. Turpentine oil (1: 7) could be used to facilitate expression of the oil. The residue was crumbly and was to be used for candles mixed with 10 per cent of beeswax or boiled linseed oil. Such mixtures could be bleached by placing in a steam-heated kettle closed with a glass window and introducing chlorin gas. The excess of chlorin was removed by boiling with water. The mixture was then melted with powdered charcoal and pressed through woolen cloths at 150° F. The product was to be called "cerine" and was to be used in candles; the expressed oil could be used in lamps, for soap, or as a lubricant.[2]

This process of Braconnot was apparently improved by Lecanu, who melted the fat and the turpentine together and then cooled before pressing.[3] The treatment with chlorin was not merely to bleach, but also to render the stearin less brittle.[4]

J. Eboli treated the pressed stearin with ether which Lecanu had earlier recommended as a recrystallizing agent for laboratory use to remove traces of turpentine.[5] It is this process that Gus-

que des bougies de composition qu'on peut faire avec ces corps seuls ou melangés aux acides gras concrets (Paris, Librairie Encyclopédique de Roret, 1849), p. 134. Also 4325, February 10, 1825. *Brevets d'invention ...* (n.d.), XLI, 296.

[1] "Patent granted to Nicholas Hogesippe Manicler, Great Guilfordstreet, Southwark, county of Surrey, for a new preparation of fatty substances, and the application thereof to the purpose of affording light. Dated March 20, 1826," *Repertory of Patent Inventions and Other Discoveries and Improvements in Arts, Manufactures, and Agriculture, etc.*, December 1827, Series 3, III, 380.

[2] The editor of the *Repertory of Patent Inventions . . . .* (*op. cit.*) wrote that the pressing of fat and the use of turpentine were well known, having been reported by Braconnot in 1815, that the patentee "being a chemist, and consequently a man of education" should have known Braconnot's work and that "he certainly has not done right in putting Mr. Braconnot's processes into his specifications as if they were his own discoveries." Rendering with steam under pressure the editor regarded as a useful improvement. French patents were issued to Manicler on August 11, 1826, and on November 3, 1826, which were declared "en déchéance par ordonnance du Roi," in No. 2006, September 25, 1832. *Brevets d'invention ...*(1832), XXIII, 22.

[3] Malepeyre, *op. cit.*, 242. [4] *Ibid.*, 243.

[5] No. 4169, March 15, 1836. *Brevets d'invention ...* (n.d.), XL, 434.

serow described as a quantitative laboratory method.[1] According to Malepeyre, the process of Eboli was probably never much used,[2] for in 1840 Tresca and Eboli took out a new patent in which the oil from previous pressings was used instead of turpentine.[3]

In 1833, Reichenbach proposed the substitution of cresol for turpentine,[4] and in 1842, de Milly received a patent for the use of shale oil (*huile volatile de schiste*).[5] As late as 1833, Schaedler referred to the addition of 10 per cent of benzene or turpentine to facilitate the expression of tallow oil from tallow.

In 1842, John H. Smith applied for a United States patent, employing alcohol or a mixture of alcohol and camphene,[6] and Morfit claimed that he rediscovered the process quite independently in 1842 or 1843.[7] He worked out the process in greater detail than Braconnot, even down to the publication of a statement of costs and profits. The process does not, however, seem to have been used commercially in America, for he complained that he was not able to interest capitalists in it on any basis satisfactory to him. He used lard or lard stearin, rather than tallow, and hoped to supplant tallow candles without competing with sperm. He submitted his process, together with samples including candles, to the Franklin Institute at Philadelphia, which awarded him a certificate of honorable mention and referred to him as "a very young man."[8] Morfit wrote with justifiable pride that his candles had received as high a premium as the adamantine (stearic acid) candles of Hancock and Mann, with which they competed, although this firm was perhaps the best of its type and although its candles were twice as expensive as his.

The use of tallow or stearin unmixed in candles was of short duration, for it was soon superseded by the use of stearic and other hard fatty acids or mixtures of fatty acids with stearin and other hard fats. The new process was made possible by the pure

[1] C. A. Gosserow, "Neue Untersuchungen über die Fette und den Seifenbildungsprozess," *Chemisches Centralblatt*, May 7, 1830, I, 145.

[2] Malepeyre, *op. cit.*, 244.

[3] No. 5874, August 14, 1840. *Brevets d'invention ...* (1843), XLIX, 423.

[4] "Besonders zusammengestellte Eigenschaften des Kresots . . . . ," *Chemisches Centralblatt*, April 17, 1833, IV, 282, a résumé of a series of articles by Reichenbach appearing in the *Journal für Chemie und Physik von Schweigger*, 1832, LXVI, and 1833, LXVII.

[5] No. 12087, March 10, 1842. *Brevets d'invention ...* (1858), LXXXIX, 17.

[6] Ellsworth, *Report of the Commissioner of Patents for 1843* (Washington, D.C., 1845), Appendix 11, p. 91.

[7] Morfit, *Chemistry Applied to the Manufacture of Soap and Candles . . . .*, 453.

[8] Campbell Morfit was born in Missouri in 1820.

science investigations of Chevreul, Braconnot, and others which had cleared up the chemical nature of saponification. The use of fatty acids for candle making was apparently proposed at about the same time and independently by the distinguished chemists Chevreul and Gay-Lussac and by the engineer Cambacérès. The new process, however, did not eliminate pressing; it involved either the pressing of the fat itself before saponification or the pressing of the fatty acids after saponification.

Gay-Lussac and Chevreul took out a French patent covering the process[1] and so did Cambacérès[2] at about the same time. Gay-Lussac and Chevreul never themselves exploited the patent. Their claims covered the use of solid fatty acids from whatever source and prepared in whatever manner; saponification under pressure; separation of the liquid from the solid acids by pressure or by extraction with hot alcohol. The fatty acids might be prepared either by acidifying the saponified material with hydrochloric acid after it had been washed to remove oleate or the saponified material might be treated with alcohol before acidification to remove oleates. The process proved too expensive and some potassium chloride remained in the fatty acids despite careful washing. This crepitated when the candles burned.[3]

Furthermore, ordinary wicks would not burn with fatty-acid candles, so that Gay-Lussac and Chevreul found it necessary to take out a supplementary patent for an improved wick, under date of August 4, 1825.[4] Unfortunately, a patent had been taken out for a similar wick on February 10, 1825, by Cambacérès. It

[1] No. 4323, January 5, 1825. *Brevets d'invention ...* (n.d.), XLI, 392. Since at that time it was not the practice of the French government to make public the text of a *brevet*, the first publication of the process was through the English patent granted to Moses Poole, Gay-Lussac's agent, in June 1825. Cf. The National Agricultural Society, *Mode of Manufacturing Sugar from Corn Stalk and of Oil and Stearine from Lard, etc.* (Washington, D.C., J. and G. Gideau, 1842), and "Stearinkerzen," *Wagners Jahres-Bericht* (1855), I, 398. Gay-Lussac's name did not appear upon the English patent, only that of his agent, Moses Poole. It is amusing to note that the patent called forth the harshest criticism. The *Repertory of Patent Inventions . . . .* (1826, Series 3, II, 138) remarks that rarely has it found so many gross errors and patent ignorance in so small a compass. One wonders whether the editor of the *Repertory* would have made his criticism had the patent been issued under the distinguished name of Gay-Lussac.

[2] No. 4325, February 10, 1825. *Brevets d'invention ...* (n.d.), XLI, 396; J. L. Cambacérès, *Mémoire sur l'application des acides gras à l'éclairage.* According to Malepeyre (*op. cit.*, 167), this memoir from which he quotes at length was presented to the Académie des Sciences in 1844, but the writers have been unable to trace it.

[3] Malepeyre, *op. cit.*, 106–8, where the essential features of the patent are reprinted.

[4] No. 4323, August 4, 1825. *Brevets d'invention ...* (n.d.), XLI, 393.

is to him that the first distinct success in the manufacture of stearic-acid candles on a large scale is due.

Malepeyre attributed the use of burnt lime to him, but in 1829 Pierre Joubert received a patent for a method to saponify tallow for candle making with unslaked lime and soda. He separated and washed the soaps thus formed, decomposed them with sulfuric acid or hydrochloric acid, washed the free acids, heated them in alcohol, and then pressed them to remove the liquid portion with the alcohol.[1] At any rate, the firm of de Milly et Motard seems to have been using burnt lime as saponifying agent in 1831. This firm became the *concessionaire* of the patents of Cambacérès and was the pioneer in the rapidly developing stearic acid–candle industry. Such candles were commonly known as stearin candles, although they were composed of stearic and related acids or of mixtures of these acids with stearin and solid fats and not of stearin alone.

The development of the stearic acid–candle industry must have stimulated the pressing of stearin. Indeed, Cambacérès in his original patent proposed to remove most of the olein by pressing before saponification.[2] However, it is not now to be determined whether de Milly and Motard pressed their tallow before saponifying it. Their patent of 1834[3] makes no mention of it. This patent is principally concerned with an autoclave provided with an agitating device to stir while saponifying under pressure.[4] W. Hempel of Oranienburg, a suburb of Berlin, took out a patent in 1836 in which as a first step olein was removed by pressing, saponification with burnt lime following as the next step.[5]

As the process was originally conducted by de Milly, tallow or other hard fat was saponified with burnt lime suspended in water, and the resulting hard, insoluble calcium (lime) soaps were separated from the aqueous liquor containing the glycerin. The fatty acids were next separated from the calcium with which they were combined in the soap by treatment with a strong acid, usually sulfuric. The melted free fatty acids were then separated from the insoluble calcium sulphate. The mixture of free fatty acids thus obtained consisted principally of stearic and palmitic acids, which are solid, and oleic acid, which is liquid. The oleic acid was separated from the other two by pressure.[6]

[1] No. 4091, September 24, 1829. *Brevets d'invention ...* (n.d.), XL, 153.

[2] *Op. cit.*

[3] No. 6440, March 3, 1834. *Brevets d'invention ...* (1844), LII, 505.

[4] Malepeyre, *op. cit.*, 114.

[5] *Ibid.*, 117.

[6] The process is described in detail in J. Pelouze and E. Fremy, *Traité de Chimie* (Paris, Victor Masson et fils, 1865, 6 vols., 3d edition), V, 856; also

Oleic acid (red oil) was, therefore, a by-product of which there was overproduction in France, and it brought a price only a little higher than half the price of tallow. It could only be used in large amount for soap. It is not suitable for illumination because it corrodes the lamps. It was used to treat wool, but this outlet was not large enough to raise the price and make a material lowering of the price of stearic acid possible. The Société pour l'Encouragement de l'Industrie Nationale in 1833 offered a prize of 4,000 francs for the manufacture of cheap candles but without results. The lowest price at which candles of good quality could be furnished remained 1.50 francs.[1] It is natural, therefore, that candle-makers sought raw materials high in stearic acid and low in oleic acid content.[2] In consequence, stearin pressed from such fats as tallow and lard must have been at a premium. W. Hempel in Berlin was separating tallow oil from tallow by graining and pressing in 1836;[3] but in France the pressing of stearin seems not to have achieved any considerable importance. Pelouze and Fremy[4] stated that up to the present it had been impossible to separate stearin industrially from tallow or other neutral fats either by pressure or with the help of solvents.

Perhaps the reason why there was so little pressing of tallow in France is to be found in the general neglect of tallow as a raw material for industry because of the general availability of olive oil. Thus, tallow was not used in soap manufacture in France till the early years of the French Revolution, although it had long been used in England and Germany.[5] Moreover, there seems

by F. C. Calvert, "On Chemistry Applied to the Arts," *Chemical News*, July 30, 1864, X, 53; reprinted in the *Journal of the Franklin Institute*, October 1865, 3d series, L, 244.

[1] Cambacérè cited in Malepeyre, *op. cit.*, 120. Also Chr. H. Schmidt, *Die Kerzen und die Seifenfabrikation* (Weimar, B. Fr. Voigt, 1852), 153. This book of Schmidt's is almost a literal translation without credit of the treatise of Malepeyre.

[2] This remained true throughout the nineteenth century. As late as 1897, J. Lewkowitsch, in a paper entitled "On Attempts to Convert Oleic Acid into Candle Material" (*Journal of the Society of Chemical Industry*, May 31, 1897, XVI, 389), wrote, "This acid [oleic] must rank in the candle works as a by-product, the sale of which for soap-making becomes more and more difficult the greater the pressure of cottonseed oil and other cheap oils is on the market."

[3] Schmidt, *op. cit.*, 151–52; Malepeyre, *op. cit.*, 117.

[4] *Op. cit.*, 889.

[5] Darcet, Lelièvre et Pelletier, "Rapport sur la fabrication des savons, sur leur différents espèces, suivant la nature des huiles et des alkalis qu'on employe pour les fabriquer; et sur les moyens d'en préparer par-tout, avec les diverses matières huileuses et alkalines, que la nature présente, suivant les localités," *Annales de chimie*, 1797, Série I, XIX, 293.

to have been no notable surplus production of tallow in France and in other European countries. Tallow was among the articles imported, principally from America and Russia. At any rate, it was in America, where there was a surplus of animal fats, that the pressing of stearin became an important industry. By 1840, lard was being pressed; the stearin obtained was known as "solar" stearin to distinguish it from ordinary stearin made from tallow. It is said to have been exported to Germany as early as 1840.[1] In the year 1841, the greatest of our Commissioners of Patents, Ellsworth, mentions the manufacture of lard oil as a newly-established industry.[2] He was quite aware of the economic significance of the new industry, for he wrote: "allowing then for the value of the stearine above the oil, and it may be safely calculated, that when lard is six cents per pound, as it is now but four or five cents at the West, a gallon of oil can be afforded there for fifty cents, since the candles from the stearine will sell for from twenty-five to thirty cents a pound." In 1842, he discussed the outlook for the lard-export trade of the United States in a manner nothing short of prophetic. He foresaw the rôle the hog was to play as a means of marketing the corn crop of the Middle West, and he predicted that for years the prosperity of this region would depend in large measure on the export of lard.[3]

Apparently, the new lard-pressing industry was regarded as important, for the National Agricultural Society published a pamphlet in 1842 describing the method of producing stearin and lard oil,[4] while Ellsworth in his report for the same year[5] recorded the establishment of several large factories in Cincinnati. Others existed in Cleveland, Chicago, Burlington, Hannibal, and elsewhere in Western and Atlantic states.

The rapid growth of the pressing of fats in the United States was stimulated by the introduction of steam rendering, described by J. R. Stafford, "Agent Cleveland Lard Oil and Candle Co.,"[6] by which it was possible to render not merely the fat that could be trimmed off the carcass but the entire carcass. Concerning the quality of the lard thus obtained, Stafford has the following to say: this "lard is good, but not equal to leaf lard or suet; the carcass fat does not contain as much concrete principle (stear-

[1] "Amerikanisches Schweineschmalz und Schweineschmalzöl," *Jahrbuch für praktische Pharmazie und Verwandte Fächer*, etc. (1850), XX, 6.

[2] *Report of the Commissioner of Patents for 1841* (Washington, D.C., 1842), 80.

[3] *Report of the Commissioner of Patents for 1842* (Washington, D.C., 1843), 42.

[4] *Ibid.*, 217. [5] *Ibid.*, 39. [6] *Ibid.*, 89.

in). Whole hog lard cannot be refined and made hard without a portion of the oil is extracted. I take from 20 to 40 per centum of the oil; then the balance goes through several washings in pure *rain water* by steam, after which it is refined lard. The expense is not more than one-quarter cent per pound, but it is of more value to us than common lard, as we have a great deal of trouble and expense with it; and in only extracting a portion of the oil, we would lose by it, did it not command a better price in the market, which it should from its purity." Stafford remarks further that he has enlarged his plant to handle 2,000 pounds of lard a day; that lard costs five cents a pound; that lard oil sells wholesale for 75 cents a gallon and retails for one dollar; that Cincinnati lard oil sells for one-third less because it is not so good as his own product.

In the light of subsequent developments, it should be noted that Stafford understood "refined lard" to be lard hardened by the expression of some lard oil and treated with pure water and steam; that Stafford used the term "whole hog lard" much as it was used later; and that the latter was a new product made possible by the newly introduced method of steam rendering. Cottonseed oil was not yet used in refined lard, for this oil was not commercially available, although attempts at commercial production had been in progress for a few years.

While steam was used to render tallow and other oleaginous materials early in the nineteenth century, it is not clear who first used steam to render materials not specially rich in fat, like slaughterhouse offal, fallen animals, etc. Bones had long been boiled with water and the oil that rose to the surface recovered, and neatsfoot oil had long been made in this way. The first recorded use of steam for this purpose seems to be the patent issued to P. L. Cambacérès in 1837. In 1832 and 1833, he had operated a factory in Buenos Aires producing grease, oil, glue, and bones from slaughterhouse offal. He steamed such material in open tanks with double bottoms and proposed to use the process to render fallen horses and other domestic animals in Paris.[1]

When steam rendering was first done under pressure is difficult to determine. It was probably done soon after the introduction of steam rendering. Papin had invented the pressure cooker in 1681. D'Arcet had used it in extracting glue from bones in 1810. Appert, the inventor of the preservation of food by heat sterilization (canning) about 1823, recommended the rendering of tallow with one-third of its weight of water in autoclaves at a

[1] No. 8806, September 26, 1837. *Brevets d'invention* ... (1847), LXIV, 458.

temperature of 115°–130° C.[1] Manicler, in 1826, was rendering fats under pressure (see p. 239); de Milly and Motard were granted a French patent for a pressure cooker with agitator in 1834.[2] Dumas, in 1843, writes of rendering with steam at 120°–130° C. and 2 to 3 atmospheres pressure without treating it as a novelty.[3] In 1844, that is, only a few years after the steam rendering of hogs began, in describing the "Steaming of Cattle, etc.,"[4] Ellsworth writes: "The great object is, however, to extract from the carcass all the oil or grease both from the flesh and bones. For this purpose, the carcass is cut in pieces and thrown into an iron cylinder capable of holding 10,000 to 15,000 pounds of beef. After the top is fastened down, steam is let in to the extent of 70 pounds to the square inch, which is equal to 306° F. After boiling 12 to 14 hours, and all the oil or grease has risen to the top, it may be drawn into barrels for the European market." Steaming was also done in large wooden tubs.[5] In 1842 a United States patent was granted to L. Moutrop of Baltimore, with the following claim: "the combined use of steam introduced into the kettle in which the tallow is melted, and around it between the kettles, thus melting tallow under high pressure."[6] Morfit described the patented pressure cooker of Wilson, of E. Wilson & Company of Cincinnati, as the best in use in 1860. The whole hogs, excepting the hams and shoulders, properly cleaned, were steamed ten to fifteen hours with a steam pressure of 50 to 75 pounds to the square inch. The digesters were tight, upright, cylindrical tanks made of boiler plate and of 12,000 to 15,000 gallons capacity. After shutting off the steam, the water from the condensed steam was drawn off and time given for settling. The fat was then drawn off. The product was superior and commanded a premium, though there was danger of contamination with water. The yield of lard was 12 per cent greater than by any other method. For tallow, the gain in yield was 6 per cent. In the West, "bones and other matters" were thrown in with the suet in preparing tallow.[7] Western lard was of granular texture, so that it was especially suitable for

[1] *Dinglers polytechnisches Journal*, 1826, XXI, 454; also *Wagners Jahres-Bericht* (1855), I, 391.

[2] No. 6440, March 3, 1834. *Brevets d'invention* ... (1844), LII, 505.

[3] M. Dumas, *Traité de Chimie Appliquée aux Arts* (Paris, Béchet jeune, 1826–46, 8 vols.), VI, 670.

[4] *Report of the Commissioner of Patents for 1844* (Washington, D.C., 1845), Appendix 35, (1), p. 396.

[5] *Ibid.*, Appendix 35, (2), p. 398.

[6] U.S. Patent No. 2694 (June 27, 1842).

[7] Morfit, *Chemistry Applied to the Manufacture of Soap and Candles* . . . ., 321–23.

the expressing of lard oil as it could be pressed without further treatment. The press cake was sometimes known as "solar stearine" and amounted to 30 to 38 per cent of the lard.[1]

Steam rendering grew rapidly in the United States. In his report for 1843 (issued 1844), Commissioner Ellsworth reported upon the growth. There were four plants using the process in Cincinnati alone. The stearin industry had also expanded. In 1842 eighty tons of lard had been worked up in Cleveland, while in 1843 two hundred and fifty tons had been converted. There were thirteen plants in Cincinnati making lard oil and stearin, with outputs ranging from 300 to 2,500 barrels of oil per annum. Stearin and lard oil were also produced at Columbus, Wheeling, Pittsburgh, Indianapolis, Nashville, Springfield, Illinois, New Orleans, Rochester, New York, New York City, and elsewhere. Reference is also made to the use of lard in the production of illuminating gas.[2] The report also contains an investigation by the Franklin Institute upon lard oil as an illuminant.

As has been pointed out (p. 243), there was in the early days of the stearic acid–candle industry little outlet for the by-product, oleic acid (red oil). It cannot be used as a burning oil, because it corrodes the metallic parts of lamps. Much work was done by chemists and inventors, through the nineteenth century and into the twentieth century, to find better outlets for oleic acid and to convert it into a solid, but the problem was finally solved only by the introduction of the hydrogenation of oils in the twentieth century (see p. 266). In the early days it was proposed, for example, to convert oleic acid to elaidic acid (melting-point 51° C.) by oxidation with nitrous acid,[3] or to split it by fusion with potassium hydroxid into solid palmitic acid and acetic acid. Attempts were also made to convert oleic acid into oxystearic acid, the lactone of which has a melting-point of 41° C. The process proposed was to add sulfuric acid at the double bond and then to saponify the resulting sulfuric acid compound with steam. Until the invention of hydrogenation, it was not possible commercially to convert liquid oils into solid fats, except by admixture of hard fats. Oleic acid (red oil) was used, therefore, principally in soapmaking and to wash wool.

However, the process using sulfuric acid combined with steam distillation was used by candle-makers. It was based upon the studies of Fremy, published in 1838, and the observations of

[1] *Ibid.*, 111.

[2] Apparently, this refers to the method of producing illuminating gas by dripping an oil upon incandescent coke.

[3] Cf. patent issued to Edward Heard in 1819, *Dinglers polytechnisches Journal*, 1820, III, 107.

Dubrunfaut and of G. F. Wilson that fats may be saponified and the resulting acids distilled in one operation by heating to 325°–330° C. and passing a current of superheated steam through the hot fat. Because of the treatment with sulfuric acid, predominantly solid fatty acids are finally obtained containing little oleic acid, which is liquid. Dubrunfaut's observations were made in 1841 and 1842. Soon thereafter, Tribouillet and Masse at Neuilly operated the process commercially.[1] The same process was developed in England at about the same time or even earlier.[2] This, then, is a process by which a higher yield of solid fatty acids fit for candle-making is obtained from fats and oils than by ordinary simple saponification. It has not been feasible to use it in the preparation of food products.

From about this time, also, dates the use of a vegetable fat, coconut oil, as a hardening agent in the candle industry. In 1840 G. F. Wilson of the Price Candle Company, while experimenting with the view of making candles which would not require snuffing, for the illumination on the occasion of Queen Victoria's marriage, discovered that a combination of coconut stearin with stearic acid would make candles giving a beautiful light but free from the necessity of snuffing. These he called "composite" and they were soon sold extensively.[3]

The Production of Illuminating Oils

Before the advent of illuminating gas and of electricity, there were two principal instruments of illumination, both used in ancient times, the oil lamp and the candle. Through the centuries, there was competition between lamp and candle, or rather between the inventors of improved lamps or better-burning oils and inventors of improved candles, a competition that subsided only with the widespread use of gas and electricity.

In northern Europe, during the Middle Ages, the rush light and the candle had the advantage. Lamps were not much used, except in churches, partly, no doubt, because they were unsatisfactory, but principally because little oil was produced, whereas there were available hard fats from the slaughter of cattle, sheep, and goats, suitable for candle-making. North of the olive-growing

[1] Described in detail by Pelouze and Fremy, *op. cit.*, 477.

[2] According to Lewkowitsch, *Chemical Technology* . . . ., III, 237, W. C. Jones and G. F. Wilson received English Patent 9542 in 1842; G. Gwynne and G. F. Wilson, English Patent 10000 in 1843; G. F. Wilson, G. Gwynne, and J. P. Wilson, English Patent 10371 in 1844; Dubovitz, English Patent 2989 in 1910; Fremy's French patent dates from the year 1855.

[3] Calvert, *Journal of the Franklin Institute*, October 1865, 3d series, L, 245.

regions, almost the only oil crops were rape, flax, and nuts, yielding respectively rapeseed, linseed, and nut[1] oils. Of these, linseed and nut oils were not available for use in cloth manufacture because they are drying oils. They soon became too expensive for food uses, because of their value in paints and varnishes, though linseed oil is still used for food in Russia, and some nut oil in France. Rapeseed oil was the principal locally produced oil available for technical uses other than painting. It is unsatisfactory as a food oil because of its disagreeable taste, though it was and is so used to some extent especially in Russia. Some whale oil was also obtained from stranded whales. Later, whales began to be caught, especially by the Scandinavians and also by the Basques about the Bay of Biscay. The fishing flourished there in the twelfth and thirteenth centuries,[2] but the production of whale oil hardly reached general commercial importance in western Europe till the beginning of the sixteenth century.[3] It then became a serious menace to rapeseed-oil producers.[4] Ultimately, the supply of whale oil became great enough to permit of its extensive use in soap.

However, even after whale oil had become available in northern Europe, the use of candles grew, because oil lamps were unsatisfactory and because whaling furnished an excellent material for candle-making—spermaceti. However, the invention of the Argand lamp in 1784 made the use of oil lamps so satisfactory as to stimulate greatly the use of illuminating oil. Inventors were spurred to discover new ways of producing oil. France was especially put to it to secure oil, because it was cut off from free access to whale oil by the English blockade of the continent. Plantings of colza and rape were increased, and methods of refining vegetable oils to make them suitable for lamps were discovered. The English, retaining free access to supplies of whale oil, continued to burn it in lamps and to use tallow and spermaceti for candles. It is perhaps due to the blockade that the French became the leaders in oil-refining and in candle-making.

The first important improvement was to treat oils so that they did not congeal easily in cold weather. This was accomplished by chilling the oil by exposure in winter until the higher-melting constituents, mostly stearin and palmitin, crystallized out. These were then separated by filtration. At a later period, the solid

[1] Principally from the seed of the walnut, *Juglans regia.*

[2] J. T. Jenkins, *A History of the Whale Fisheries* (London, H. F. and G. Witherby, 1921), 61.

[3] Tower, *op. cit.*, 11 ff.

[4] Jenkins, *op. cit.*, 68–69.

material filtered off was pressed to recover the oil mechanically adhering to the stearin. The process is known as "winterizing" or "demargarination," and the treated oil as "winter oil." The writers have been unable to determine who first used this process. It is probably an ancient one that was perhaps first extensively used in connection with the preparation of spermaceti from sperm oil. Braconnot (see p. 237) described the fractionation of oils in this manner. Ellsworth[1] refers to the use of winter stearin for culinary purposes, for which use it was found to compare favorably with leaf lard.

The next important step was the preparation of oils from solid fats in the manufacture of stearin, a process that has already been described (p. 235). In this way, oil for lamps could be produced in countries where only solid animal fats were available. We have already seen that the pressing of fat to produce stearin for candle-making became an important industry in the United States. The fact that oil was produced jointly with stearin helped pressing to become established. Pressing lard became especially profitable because the lard oil produced jointly with stearin was particularly suitable for lamps and for other purposes. Ellsworth stated (1841) that lard oil had been found superior to olive and sperm oil for machinery; that it is better than sperm oil for the blowpipe and that it is a good burning oil. He also presented comparative analyses of lard and sperm oil as well as directions for the use of lard oil for lighting and for the construction of proper lamps. He further said that it was being tried out in England for combing wool, an order for 600 gallons having been received from a factory at Huddersfield, England. The export to England is said to have amounted to 16,000 barrels.

Even at this early date, lard oil was being winterized, for Ellsworth writes: "An objection has been made against lard oil, that it is not capable of being preserved in a liquid state in cold weather; but by a process similar to that by which the winter sperm is prepared lard oil can be made which will not chill at 30° F."

Lard oil is said to have been used as early as 1840 to adulterate sperm oil in the United States and in France to adulterate olive oil.[2]

The rapid growth of the lard-pressing industry is well illustrated by a quotation from the *Journal of Commerce* to the following effect: "Heretofore the whale fishery has supplied light

[1] *Report of the Commissioner of Patents for 1844*, 118, 170.

[2] *Jahrbuch für praktische Pharmazie und verwandte Fächer, etc.* (1850), XX, 6.

for a vast portion of the country. In all the large towns and villages sperm oil has been sold freely. That trade has suddenly ceased. This spring there has been almost no demand from the interior for sperm oil, and very little from the city. Camphine and lard oil have supplied the demand at a cheaper rate. Crude sperm oil has fallen one-third in price, and yet remains neglected. The hogs have fairly run the whales out of the market, and are likely to hold their ground, unless some new process of cheapening can be contrived on the other side. The woods of the West are more full of the quadruped than any ocean is of the finny whale, and the quadruped is much more easily taken. The way now is to turn the 'whole hog' into oil."[1]

The Refining of Oils

The fats of domesticated animals, if prepared in a cleanly manner from fresh, edible material, are fit for food without further treatment; but only a few vegetable oils, for example olive, almond, and sesame oils, are acceptable for food purposes without refining. Indeed, the best grades of these oils are not refined because they lose their highly prized flavor. However, most oils, as they come upon the market, are objectionable in taste, odor, or color because the conditions of their production necessarily involve the employment of raw materials more or less fermented or decomposed. Most of the oil available in northwestern Europe has been of this character, though in recent decades there has been a tendency toward improvement of quality, especially of palm and whale oils. Most of the oil is, nevertheless, still objectionable in odor, and more or less rancid, with a high fatty-acid content. Oil in this condition is desirable neither for food uses nor for illumination. It spreads a disagreeable odor when burned in lamps and the free fatty acid tends to corrode the metal parts. Therefore, about the end of the eighteenth century, there was much experimentation to develop methods of refining that would remedy these defects of the cheaper oils then available.

Two methods were developed. One, employing strong sulfuric acid, was said to have been originated by Gower in 1792 and perfected by Thénard in 1801.[2] Desormes, however, attributed the discovery to Carcel.[3] The second method employs strong caustic

[1] Cited in *Niles' National Register*, June 25, 1842, Fifth Series, XII, 272.

[2] Kamarsch, *op. cit.*, 838; F. Knapp (translated by E. Ronalds and Th. Richardson), *Chemical Technology, or Chemistry Applied to the Arts and to the Manufactures* (London, Hyppolyte Baillière, 1848), I, 109.

[3] Clément-Desormes, "Conservatoire des Arts et Métiers," *Recueil industriel*, January 1829, 74; abstracted in *Dinglers polytechnisches Journal*, 1829, XXXII, 104.

alkali and has been variously attributed to Cambacérès,[1] to Cogen,[2] and to Barreswill.[3] As a matter of fact, Barreswill did not claim to be its discoverer. He merely described the method and pointed out that, while not at the time in widespread use, it was destined to compete with the sulfuric-acid method of Thénard.

In 1840 a patent was issued to L. A. Bourgais for a method using a solution of soda by which all the coloring matter was precipitated in the form of soap.[4]

In 1842 a patent was issued to Auguste Schmersahl of Paris for the purification of cottonseed oil based upon partial saponification with caustic alkali, preferably burnt lime. The oil was mixed cold with milk of lime of a strength of 1°–1.5° Baumé, boiled two to three hours, separated from the coagulum formed, and finally filtered with granulated or powdered animal charcoal.[5]

P. Bancroft was granted an English patent in 1846 for purifying fats and oils. Tallow was melted with steam to just above its fusion point and a strong solution of caustic potash was then added with vigorous stirring so long as a precipitate formed. The precipitate was allowed to settle and was then removed.[6] This is essentially the present-day method of refining cottonseed oil, but Bancroft's main purpose seems to have been to improve color.

Cambacérès in 1844 obtained a patent[7] involving an analogous procedure as a preliminary step in soap-making. The oleaginous material was digested with aqueous weak alkali for some hours. The aqueous liquid was then drawn off and a small amount of very concentrated lye added, which precipitated most of the coloring matter. This was then removed and the saponification continued in the usual way.

These alkali methods were nothing more than a practical application of a phenomenon well known to soap boilers, viz., that, in boiling soap, dark impurities, known as the "nigger," may settle out in the kettle and form a layer between the lye below and the clear soap on top. Indeed, the method was probably used before 1800, for Dossie[8] in 1803 described the use of a combination of chalk, slaked lime, and pearl ash in water to purify train

[1] Schmidt, *op. cit.*, 158.

[2] Knapp, *loc. cit.*

[3] L. C. A. Barreswill, "Variétés," *Journal de pharmacie et de chimie*, 1858, Troisième Série, XXXIII, 446.

[4] No. 7765, October 8, 1840. *Brevets d'invention* ... (1846), LIX, 287.

[5] No. 6864, May 7, 1842. *Ibid.* (1845), LIV, 472.

[6] Malepeyre, *op. cit.*, 115.

[7] No. 8087, January 23, 1844. *Brevets d'invention* ... (1846), LXI, 106.

[8] R. Dossie, "The Principle on Which the Purification of Fish Oils May Be Performed, and the Uses to Which It Is Applicable," *Journal of Natural Philosophy, Chemistry, and the Arts*, May 1803, V, 13.

oil as by no means a novelty. Moreover, sperm oil was refined or "physicked" with caustic potash,[1] and this alkali was also used to purify spermaceti.[2]

However, refining with caustic alkali does not seem to have come into use for refining oils in general much before the middle of the nineteenth century, for Knapp speaks of it as a method requiring "further experiment to prove its advantage." In the end, it became widely used, except for very special oils.[3] When it was first introduced in America, the writers have been unable to ascertain. The methods first used for the refining of cottonseed oil were treated as trade secrets, but it seems likely that cottonseed oil was soon refined with caustic alkali, presumably pearl ash, for this was a customary practice in lard refining at that time. Nor is it clear when, in America, the cheaper but equally effective caustic soda was substituted for the dear caustic potash (pearl ash). Certainly as late as 1883 the N. K. Fairbank Company used pearl ash in lard refining. David Wesson was responsible for the shift of this company to caustic soda.

Bleaching Oil

The refining of oils was not enough to make them acceptable for culinary purposes; dark oils had still to be decolorized or bleached. Even for illumination a white oil is preferred by users, though for this purpose the only advantage may be its cleaner appearance. Aside from exposure to sunlight, the first bleaching process seems to have been to blow air and steam through the oil.[4] Subsequently, bleaching was done with "high steam."[5] G. Gibbs bleached palm oil at 110° C. by blowing steam through it supplied from a boiler at a pressure of two atmospheres.[6]

The introduction of palm oil, which is orange colored, furnished a strong incentive to search for satisfactory methods for bleaching fats and oils. This oil was perhaps the first tropical oil to be introduced to the European market in quantity. The reason is to be sought in the commerce brought about by the slave trade between Europe and that part of Africa that lies about the Gulf of Guinea, the home of the oil palm. Manufactured

[1] Morfit, *Chemistry Applied to the Manufacture of Soap and Candles . . . .*, 507.

[2] No. 2660, January 5, 1825 (issued to M. L. A. Leroux Lajonkaire). *Brevets d'invention ...* (1836), XXVIII, 301; also Knapp, *op. cit.*, 119.

[3] For a description of the method, see Appendix A, under "Refining."

[4] Colin, "Expériences relatives à la fabrication des Savons durs," *Annales de chimie et de physique*, September 1816, Série 2, III, 1.

[5] Morfit, *Chemistry Applied to the Manufacture of Soap and Candles . . . .*, 112.

[6] Malepeyre, *op. cit.*, 206.

goods had to be sent there to pay for slaves and return cargo space to Europe was available. There was a sort of three-cornered trade. Europe sent manufactured goods to Africa; Africa sent slaves to the Americas; and the slaver was paid in bills of exchange based ultimately on exports from the Americas to Europe. With these goods, the slaver liquidated his debt to Europe for manufactured goods. The palm-oil trade originally was merely an incident of the slave traffic; the oil was carried instead of ballast. But with the suppression of the slave trade, it assumed an importance of its own, and a satisfactory method of bleaching it became important. The earliest method seems to have been by exposure to sunlight. This method, apparently, was first proposed by Lampadius, in 1832.[1] However, wax for candle-making had for many years been bleached in this way and it was the common way to bleach tallow candles. The process was later improved in that the oil was exposed to sunlight in a thin layer floating on a water surface, while the lower water layer was warmed by means of a steam coil. The oil was bleached in this way in ten to fifteen hours.[2] Zier recommended running palm oil slowly in a thin layer over warm metal plates. The oil absorbs oxygen, gives off vapors of strong odor, and becomes white. The process was used in England.[3]

Michaelis bleached with sulfuric acid and peroxide of manganese.[4] Others used chlorin, usually derived from calcium hypochlorite.

Cottonseed oil seems to have been bleached by exposure to sunlight in the early days. The N. K. Fairbank Company had large tanks on the roof of its factory for this purpose. Care was taken to have no more than a depth of two feet of oil in them, so that light might penetrate to the deeper strata. The method was of course unsatisfactory, because it tied up much capital and required much space and, above all, because the oil tended to deteriorate. The chemical methods of that period were not suitable for food oils. The most generally used of these was treatment with sulfuric acid and potassium bichromate, for which Charles Watt, Sr., received an English patent in 1845.[5] This

[1] *Erdmanns Journal*, XIV, 455; abstracted in *Chemisches Centralblatt*, October 6, 1832, III, 717.

[2] *Journal de chimie medicale*, Série 2, VIII, 121; abstracted in Sillman's *American Journal of Science*, October 1844, XLVII, 196. Also Malepeyre, *op. cit.*, 203.

[3] Malepeyre, *op. cit.*, 197.

[4] *Ibid.*, 196.

[5] C. Watt, Sr., "On Chromic Acid as a Bleaching Agent and a Cheap and Easy Means of Recovering It," *The London Journal of Arts, Sciences and Manufactures and Repertory of Patent Inventions*, 1848, XXXII, 134.

method yields a product which is white, but of bad flavor. Some cottonseed oil was so bleached to sell to miners for use in lamps.

Sometime during the nineteenth century charcoals began to be used to a limited extent in Europe to bleach oils. No record of their use for this purpose in America has been found. As early as the fifteenth century, wood charcoal was known to decolorize fluids,[1] but it was not used for this purpose till toward the end of the eighteenth century.[2] It began to be used in laboratories and later in the refining of raw sugar. According to de Fontenelle,[3] Denis de Montfort described a carbon filter for oil. About 1818 Braconnot and Simonin used it in preparing stearin (see p. 237). In the middle of the nineteenth century, animal charcoals and the residues from the manufacture of potassium ferrocyanid were employed, but they never came into general use because they were fairly expensive and retained 100–250 per cent of their weight of oil. Their use was, therefore, fairly costly, and was abandoned when the decolorizing by bleaching earths was discovered.[4]

The use of these earths, though proposed earlier, was an American achievement. Clays and various white earths had been used in ancient times as detergents, since many varieties of them absorb grease readily. With the growing use of soap, unknown in the Mediterranean world before the Christian era, the use of clays became less common. It survived principally in the fulling of cloth.[5] Fuller's earth seems to have been proposed to bleach wax as early as 1774,[6] and was used by Wilks[7] early in the nineteenth century in treating vegetable oils. Wilks treated rape or other oil with sulfuric acid and fuller's earth; then added burnt lime and heated with water; and, finally, decanted the clear oil. It is

[1] I. Davidsohn, *Die Bleichung der Öle, Fette, Wachse und Seifen* (Berlin, Gebrüder Borntraeger, 1931), 96.

[2] T. Lowitz, "Neue Anwendungen der Kohlen durch ihre Reinigungskraft; nebst fernern Erläuterungen, um dem Miszlingen bey ihrem Gebrauche sicher auszuweichen," *Chemische Annalen für die Freunde der Naturlehre, Arzneygelahrtheit, Haushaltungskunst, und Manufacturen von D. Lorenz Crell . . . .* (Helmstädt, G. G. Fleckeisen, 1784–1804), 1793, I, 3.

[3] J. de Fontenelle, *Nouveau manuel complet du fabricant et de l'épurateur d'huiles*, new edition edited by F. Malepeyre (Paris, Librairie Encyclopédique de Roret, 1852), 209.

[4] Davidsohn, *op. cit.*, 7.

[5] Cf. J. Beckmann (translated by W. Johnston), *A History of Inventions and Discoveries* (London, Longman, Hurst, Rees, Orme, and Brown, 1817, 3d edition), 247. Cloth cleansers in ancient Rome were known as *fullones*.

[6] A. and C. R. Aitkin, *A Dictionary of Chemistry and Mineralogy, with an Account of the Processes Employed in Many of the Most Important Chemical Manufactures . . . .* (London, J. and A. Arch [etc.], 1807), 488.

[7] *Dinglers polytechnisches Journal*, 1829, XXXI, 236.

not plain whether he understood the rôle played by the fuller's earth in the process. In 1880 Alexander W. Winter secured a United States patent[1] for purifying animal and certain vegetable oils by melting, mixing with pulverized fuller's earth, and separating the earth from the oil or fat.

However, there is no evidence that bleaching earths were in practical use until they were adopted by the N. K. Fairbank Company. In the early days, trained experts were not employed in the fat and oil industries in America—at least their employment was exceptional. No chemist, for example, was engaged in the Chicago meat-packing district until the N. K. Fairbank Company in 1879 employed William B. Allbright, a young graduate of the Massachusetts Institute of Technology and a student of Professor John M. Ordway. In 1883 David Wesson, another young graduate of the Massachusetts Institute of Technology, became his assistant. He soon succeeded Allbright as chief chemist, for Allbright elected to take charge of the new refinery erected by the company in New York, and in 1887 left the employ of the company. A number of practical men, engineers, mechanics, and later chemists, including Boyce, Eckstein, and Burnham, were associated with Allbright and Wesson. They formed a co-operating group, and it is not always clear which one originated an invention or a new process.

About 1880 Allbright and Eckstein introduced the use of fuller's earth for the bleaching of lard and cottonseed oil. It is said that one of the employees of the N. K. Fairbank Company, a Mr. Bauscher, learned from a person who had lived in Morocco that the natives of that country sometimes bleached olive oil with a kind of clay. Accordingly, many samples of clay were secured from different parts of the world and tested. A clay from England, known then as fuller's earth, was found most effective.[2] It adsorbs basic dyes. A patent covering the use of fuller's earth was issued to Allbright in 1886.[3]

Lard or oil was heated with one-half of one per cent to two per cent of fuller's earth, according to the quality of the latter. If too high a temperature is maintained or too much earth is

[1] U.S. Patent No. 233,452 (filed June 22, 1880; issued October 19, 1880). The writers have been able to learn little concerning Alexander W. Winter, except that he lived at one time in San Francisco and is the author of two books on meat packing-house practice: *Packers' and Refiners' Encyclopedia* . . . . (Chicago, Laird and Lee, 1893), and *Winter's Handy Book of Reference* . . . . (Chicago, Laird and Lee, 1894), which is a cheaper, abbreviated edition of the preceding work.

[2] Similar clays were later found in the United States and utilized. Cf. C. L. Parsons, *Fuller's Earth* (U.S. Bureau of Mines Bulletin 71), 1913.

[3] U.S. Patent No. 345,872 (July 20, 1886).

added, the fat acquires an earthy flavor. The removal of the earth was at first accomplished by settling and decantation. Soon, however, filter presses were used for the purpose, but the retention of oil by the earth in the press cake entailed heavy losses. In 1883, H. G. Eckstein, also of the N. K. Fairbank Company, conceived the simple idea of passing dry live steam at a pressure of 40 to 60 pounds to the square inch through the caked fuller's earth, which remains in the filter presses, whereby about 75 per cent of the retained fats were reclaimed from the mass. This procedure was also covered in the Allbright patent above cited.

The introduction of fuller's earth largely solved the problem of bleaching cottonseed oil, though its use still entails considerable loss of oil retained in the earth. This it has been proposed to recover by extraction with solvents, but, so far as the writers have been able to learn, the proposal has not been adopted in America.[1] The fuller's-earth method soon superseded all other methods theretofore in use, and remains the principal method today, although, as we shall see, the use of charcoals is coming back.

The fuller's earth first used was imported from England. After 1890, deposits were discovered in Arkansas, Florida, and elsewhere, but bleaching earths from these sources were largely used to refine petroleum products rather than fats and oils. Subsequently deposits were discovered elsewhere, and in Germany methods were discovered for activating relatively inactive earths, principally by acid treatment.[2] The extensive use of such activated earths was forced upon Germany during the war. Attempts have also been made to prepare bleaching earths synthetically.[3]

The war had another effect. It brought back the use of active charcoals, or as they are now known, activated carbon,[4] for charcoal was the principal agent used in gas masks. A vast amount of research upon the activation of carbon was done, so that after the war very active carbons began to be placed upon the market and numerous process patents have been issued.

Active carbons are used to bleach oils in the same manner as fuller's earth, except that instead of adding the carbon all at once as the earth is added, it is more economical to add the carbon

[1] For a description of the various methods proposed to recover oil retained by the fuller's earth, see Davidsohn, *op. cit.*, 76.

[2] Cf. Davidsohn, *op. cit.;* also O. Eckart and A. Wirzmüller, *Die Bleicherde* (Braunschweig, Serger und Hempel, 1925), and O. Kausch, *Das Kieselsäuregel und die Bleicherden* (Berlin, Springer, 1927).

[3] E. Silvermann, *Versuche zur Gewinnung synthetischer Bleicherden* (Berlin, Inaugural Dissertation, 1930).

[4] Cf. O. Kausch, *Die Aktive Kohle* (Halle, Knapp, 1928).

in successive portions at 15- to 20-minute intervals. The advantage of using carbon is that much less is required than of fuller's earth, since carbons may be 10 to 20 times as active as the best earths. In consequence, less oil is retained by the decolorizing agent, and the oil losses are thus reduced. Moreover, carbon does not give the oil an off-flavor as fuller's earth sometimes does. Against these advantages must be balanced the greater cost of the carbon; despite its greater activity, decolorizing with carbon may therefore be more expensive than with fuller's earth. Hence some refiners use a mixture of active carbon and fuller's earth, for it has been found that such a combination is more effective than would be expected from the sum of the decolorizing powers of the two agents used separately. Moreover, it seems possible to carry the decolorizing of refractory oils further with carbon than with fuller's earth.

Other combinations with fuller's earth are also in use, and in recent years there seems to be a trend back to the use of chemical bleaching, such as oxidation with air, ozone, hydrogen peroxid, other peroxids, hydrosulfurous acid (blankite), sulfuric acid, organic acids, and alkalis. Most of these procedures are used for non-food oils. For details, the reader is referred to the monograph of Davidsohn.[1]

Before leaving the subject, it should be pointed out that sharp distinctions cannot be drawn between refining, bleaching, and deodorizing, for each of these processes may at the same time have more or less the effects of the other two. Thus, the purpose of refining with strong caustic alkali is to remove free fatty acids and other impurities, but incidentally some bleaching and some deodorizing is brought about.[2]

Mention must also be made of the custom in the early days of coloring some brands of compound yellow with annatto. Apparently, this was done either because Cottolene (an N. K. Fairbank Company product, see p. 29), which was made of yellow oil, set the fashion or because some portions of the consuming public regarded the yellow color as indicative of richness. The yellow brands seem to have been in special demand by commercial bakers.

Deodorizing Oils

While the use of fuller's earth solved the problem of decolorizing cottonseed oil, the removal of odor and flavor still presented difficulties. The flavor and odor limited the uses to which

[1] *Op. cit.*

[2] *Ibid.*, 9 and 186.

bleached cottonseed oil could be put. The deodorizing of fats by boiling with water and by blowing steam through them had been practiced for some time.[1] Cameron decolorized palm oil, heated to 110° C., with high pressure steam as early as 1845. About 1891, Eckstein succeeded in deodorizing cottonseed oil by blowing high-pressure steam through the oil, heated to 340° F., in inclosed kettles with openings at the top to permit the exit of the steam with the volatile or objectionable portions of the oil. After Eckstein left the employ of the N. K. Fairbank Company, James Boyce, chemist of the American Cotton Oil Company, improved the method by perfecting the equipment and the methods of operation.

The final step in deodorizing was taken by Wesson about 1900, after he had left the American Cotton Oil Company. It consisted in deodorizing by treating the oil with steam *in vacuo*, and permitted a lower temperature than when no vacuum was used, thus avoiding the danger of imparting a cooked flavor. Carefully refined and decolorized oil subjected to this treatment is not merely better in odor and flavor, but also of better keeping quality than oil treated by the earlier process.

Early Forms of Compound in Europe

We see, then, that by the early 1880's technology had set the stage for the emergence of a compound industry, at least in America. Methods had been developed for preparing hard fats (stearin), and for refining many sorts of oil so as to make them edible. All that was necessary to produce compound was to blend such hard fats and oils together. However, the production of solid edible fats, i.e., compound, from oils had been attempted earlier. In 1855 Puscher[2] reported that for about two years previously a "lard oil" and a "lard butter" had been manufactured in Hamburg and Leipzig by heating rape oil with potato starch until its disagreeable odor and taste had disappeared. The carbonized starch was allowed to settle and the clear oil was decanted. By mixing two parts of the oil with one part of freshly rendered beef fat, lard butter was obtained.

In 1875 Jakobsen[3] stated that this sort of artificial lard or oil lard had been made as a butter substitute in Nürnberg and

[1] Cameron, *Polytechnisches Centralblatt*, Band 4, Heft 5; abstracted in *Chemisches Centralblatt*, October 27, 1845, XVI, 734.

[2] C. Puscher, "Die Bereitung von Schmalzöl und Schmalzbutter," *Dinglers polytechnisches Journal*, 1855, CXXXVI, 231.

[3] Emil Jakobsen, "Ueber die Bereitung von Kunstbutter," *Chemisch-technisches Repertorium*, 1875, Erstes Halbjahr, 186.

elsewhere in Germany for more than fifty years, both for domestic purposes and for export. The oil was heated with potatoes and onions,[1] the steam thus generated having the effect of a steam distillation in removing the sulfur-containing ingredient of the oil. The rape oil thus purified was melted with enough tallow to give the desired consistency. The product could not have been very efficiently deodorized, for Jakobsen remarks, while discussing the oleomargarine industry which was then new, that this rape-and-tallow compound would create a prejudice against oleomargarine, since it was of poor quality in that it had a bad odor and easily turned rancid. This remark also indicates that the product must have been fairly well known and of some commercial importance.

Wagner, however, took exception to Jakobsen's statement,[2] and attributed the invention to Puscher. However, it seems to be a fact that rape oil had been customarily rendered edible in the manner described by Jakobsen in many German homes for a long time previously.[3] Bread crusts were used in this way in Flanders and Brabant.[4] This lends support to the statements of Jakobsen which may have been drawn from the book on soapmaking by Leuchs, to which Jakobsen makes reference.[5] Puscher's process was obviously only the improvement of a method that had long been in daily use by the working classes in many parts of Germany. In northern Germany, rape oil was heated with pieces of bread or bread crusts till these were charred and the greater part of the flavor of the oil had been removed.[6] In doubt is left only the question whether Puscher was the inventor of the use of tallow to harden an oil. That he was may be doubted, for the idea is an obvious one. Dossie, in 1803, described the thickening of fish oil[7] for use in woolen manufacture by adding tallow, or fat, or "the refuse grease of families, commonly called *kitchen-stuff*." Moreover, tallow has been mixed with lard by farmers and others for decades, perhaps for centuries. A report

[1] The use of onions for this purpose was also recommended in 1834. *Pohl, Hauswirthschaftliche Neuigkeiten*, 1834, No. 1, 55; abstracted in *Pharmazeutisches Central-Blatt*, August 2, 1834, Fifth Year, Vol. II, No. 36, p. 573.

[2] J. R. Wagner, *Jahresbericht über die Fortschritte der chemischen Technologie* (Leipzig, Wiegand, 1876), 1029.

[3] Wagner, *op. cit.* (1855), 257.

[4] See de Fontenelle, *op. cit.*, 211.

[5] Leuchs, *Der Europäische Seifen-Fabrikant* (Nürnberg, 1869). This treatise was not accessible to the writers.

[6] The practice seems to be an ancient one; Sir Hugh Plat attributes it to the cook of Pius V in *The Jewel House of Art and Nature* (London, Bernard Alsop, 1653), No. 131, p. 182.

[7] Dossie, *op. cit.*, 15.

of the New Hampshire State Board of Health, prepared in 1890, contains the following sentence: "Beef stearine or suet has been mixed with lard for years, and among farmers is considered better for summer use than the pure leaf, in consequence of the melting-point being a little higher."[1] It is unlikely, therefore, that the stiffening a soft fat or oil with tallow was first practiced by Puscher. Indeed, his article contains no specific claim of priority, nor does he seem to have sought any patent protection.

As already stated, there was great economic pressure in the first half of the nineteenth century to produce very hard fats for the candle-maker and oils to take the place of whale oil; but there was little economic pressure to produce substitutes for solid edible fats except butter. A number of efforts were made in this direction from 1860 to 1870, which culminated in the invention of oleomargarine by Mège-Mouriez in 1869. The economic effects of the rise of the oleomargarine or margarine industry have been treated in the main body of the text. Here, it is only necessary to point out that the manufacture of margarine depended upon the pressing of edible tallow. Had not the processes of pressing fats for illuminating purposes been developed, margarine could not have been invented at that time.

With the growth of the margarine industry, large quantities of edible stearin became available. This, as pointed out in the main body of the text, sought an outlet. Its use to stiffen soft lards took only limited amounts. Moreover, the lard-pressing industry at about this time began to suffer from the competition of petroleum products, illuminating oil, and paraffin. Whale oil was driven altogether out of the illuminating field and lard oil was restricted to a few uses: as an illuminant for railroad-signal lights, lighthouses, and beacons. In this very limited field, lard oil maintained itself for a time, but in recent decades it has been largely displaced by mineral-oil products from even this modest use. Lard oil remained in use as a lubricant, but, as time went on, its use was more and more restricted even in this field; today, it is used as a lubricant only for special purposes, especially as a "cutting oil" to lubricate the cutting edge of tools in metal working.

Stearin fared somewhat better than lard oil as regards its use in the arts, for though illumination with gas, with petroleum, and finally with electricity limited the use of candles, candles have not wholly disappeared as has the whale-oil lamp. Candles are still extensively used even today under a variety of circum-

[1] *House Reports*, Vol. 3, No. 970, 1889–90, Part 2, p. 14 (51st Congress, First Session, Serial No. 2809).

stances and for a variety of purposes.[1] Candle-making is still an important industry, though candles are not now always made wholly from fatty acids. Considerable quantities of paraffin are also employed. Paraffin was first used in small amounts to overcome the brittleness of stearic-acid candles. By 1860, paraffin had already become an important candle-making material, though it was expensive and not yet derived from petroleum. Earth wax (ozocerite) was used and also paraffin obtained in England from the distillation of shale. It was also obtained in Europe by distilling wood and coal. It sold in the United States in 1860 for 50 cents a pound.[2] When, as the petroleum industry grew, paraffin became cheap as compared with stearic acid, it displaced stearic acid to some extent, at least in the cheaper grades of candles. This lessened use of stearic acid has in more recent years been counterbalanced in part by the new uses of stearic acid that were unknown or unimportant seventy-five years ago. For example, zinc stearate is widely used in medicine as a dusting powder and in ointments. Today, of course, stearic acid is made principally from greases and inedible tallow or from the stearins derived from them by pressing.

The point to be made in this connection is that the narrowing

[1] According to the Census of 1810, there were produced in the United States 3.8 million pounds of candles valued at $508,606, or an average of a trifle more than 13¼ cents a pound. Of this production, there were exported 187,190 pounds of spermaceti candles, 7,636 pounds of wax candles, and 618,039 pounds of tallow candles, or 812,875 pounds in all (Pitkin, *op. cit.*, p. 65). Exports fluctuated greatly, the maximum export of tallow candles prior to 1810 having been 266,084 pounds in 1804 and of sperm candles 294,789 pounds in 1806.

In 1925 the value of candles produced was $7,578,230; the volume of production is not given by the Census. In the same year, there were exported 1,383,936 pounds valued at $251,618 or 18.18 cents a pound. Assuming the average value of the candles consumed and not exported to be the same as those exported, the total production for the year 1925 would have been 41,684,433 pounds. Deducting exports and adding imports leads to a figure for per capita consumption of 0.3019 pounds. An exactly equivalent figure for 1810 cannot be arrived at, for the writers have not been able to find data on imports in that year. However, deducting exports and making no allowance for imports, we obtain a per capita consumption of 0.5292 pounds. These figures are, of course, not strictly comparable for a number of reasons that cannot be set forth in detail here. Nevertheless, the inference is warranted that the per capita commercial production of candles in the United States is today of the order of magnitude of about three-fifths that of 1810, whereas the total volume is very much greater than it was in 1810. Apparently, the relative importance of the candle industry today is not so much less than in 1810 as one might suppose. However, one cannot regard the figure for 1810 as representing total consumption, for candles were very generally made at home for home use. Concerning the volume thus produced there is no information, but it was probably many times the commercial production.

[2] Morfit, *A Treatise on Chemistry Applied to the Making of Soap and Candles*, 543–44.

of the market for lard oil forced lard pressers to sell lard stearin —as well as lard oil—on a narrow margin. The tendency was to depress the price of all stearin, the inedible as well as the edible obtained as a by-product in margarine manufacture. The pressure to find new outlets for edible stearin was great. As has been pointed out in the text, at first it took the form of adulterating lard; and a further outlet was found by making lard substitutes from lard, stearin, and cottonseed oil, or from stearin and cottonseed oil alone. The economic pressure to utilize stearin and cottonseed oil developed at about the time when sufficient progress had been made in technology to facilitate such utilization.

Early Progress in the Manufacture of Compound in the United States

From cottonseed oil and stearin, compound with a smooth, firm texture resembling lard could not be made by cooling the melted mixture by the methods then current for cooling lard. Lard contains relatively little of high-melting constituents; hence, slow cooling was satisfactory, provided in due time the melted lard got stiff enough to package without too much grain. The N. K. Fairbank Company used the Allen lard cooler and ice water.[1] However, after the addition of cottonseed oil and beef fat to lard, there was a tendency for the stearin to separate from the melted mixture at a temperature above that suitable for drawing the mixture into packages. At this temperature, the beef stearin appeared and continued to separate as the slow cooling went on. Allbright discovered that this difficulty was avoided by sudden chilling, but the resulting firm fat was translucent and, therefore, not marketable as lard. The difficulty was overcome by the invention of the lard-cooling roll with the help of O. G. Burnham, to whom patents covering the invention were issued in 1883.[2] The lard roll consists of a revolving hollow metal cylinder chilled by circulating cold water or chilled brine through its interior. The melted lard or compound is allowed to run in a thin film over the revolving cylinder on which it is almost instantly chilled. The thin layer of fat is then scraped off automatically and drops into a trough within which a picker shaft and a worm conveyer beat it up to destroy the translucent appearance. This lard roll, which is now in almost universal use,

[1] W. B. Allbright, "Practical Considerations in Lard Manufacture," read before the American Meat Packers Association at Chicago, October 12, 1909, in *Catalogue No. 3*, The Allbright-Nell Company, Special Lard Machinery, Chicago, 1909.

[2] U.S. Patents No. 287,362 (October 23, 1883) and No. 289,809 (December 11, 1883).

made possible the admixture of a greater proportion of oil with a lesser proportion of hard fat in the adulteration of lard. Many other devices for cooling lard have been in use before and since the issuance of the Burnham patents, but the cooling roll has displaced nearly all of them. The lard roll proved particularly effective because at about this time there came into use the ammonia refrigeration machine, which rendered feasible the employment of very cold brine to chill the roll. Prior to some time in the 'eighties, the only mechanical refrigeration known in the Chicago stockyards district was by means of machines of the Windhorst type, operating by compressing air, cooling it when compressed, and then allowing it to expand.

Opinions have differed concerning the reasons why sudden chilling has the effect above described. Allbright says that "sudden cooling would combine all the fats."[1] The effects of sudden chilling are now better understood. Fats exhibit curious anomalies in regard to their melting and congealing temperatures. These do not coincide, as theoretically they should. Various explanations have been offered, among others that triglycerids exist in different forms according as they are cooled slowly or chilled rapidly. These forms are assumed to have different melting points. Eldred, at the Food Research Institute, has been able to show that in fact fats do exist in several forms, depending upon the rate of cooling.[2]

Hydrogenation

We see, then, that by 1900 the problem of refining, deodorizing, and decolorizing cottonseed oil for edible purposes had been solved. However, the amount of cottonseed oil that could be used in the manufacture of solid cooking fats was limited by the supply of stearin. Therefore, despite the growing use of the solid vegetable fats, coconut oil, and in Europe palm kernel oil, the problem of hardening oils continued to engage the attention of chemists. Some of the early endeavors of this sort have been mentioned above. A number of laboratory processes were tried out by the candle industry in the second half of the nineteenth century but failed.[3]

Some of the early methods endeavored to hydrogenate fatty acids rather than the neutral fats; they are described by Ellis[4]

[1] Allbright, *op. cit.*

[2] F. H. Eldred, unpublished material.

[3] Lewkowitsch, "On Attempts to Convert Oleic Acid into Candle Material," *Journal of the Society of Chemical Industries*, 1897, XVI, 389.

[4] Carleton Ellis, *Hydrogenation of Organic Substances Including Fats and Oils* (New York, Van Nostrand, 1930, 3d edition), 313–16.

and by Lewkowitsch.[1] Hydrogenation is a chemical process by which unsaturated organic substances (see *Unsaturated compound*, Appendix A) are made to take hydrogen into the molecule. Most fats and oils contain the glycerids of unsaturated fatty acids, which are liquid at ordinary temperatures. If they are made to combine with hydrogen, they become more nearly saturated (with respect to hydrogen). One of the effects is to raise the melting-point; if the process is carried far enough, a liquid fat, i.e., an oil, may be converted into a solid fat. Success in hardening oils (i.e., triglycerids rather than fatty acids) by hydrogenation was finally achieved in 1902 through the use of finely divided metals as catalysts.

As early as 1863, Debus had shown that, if vapor of hydrocyanic acid (HCN) mixed with hydrogen be passed over platinum black, methylamin (H_5CN) is formed.[2] It is obvious that this is a reaction involving the addition of hydrogen to hydrocyanic acid; it is hydrogenation. Somewhat later, Saytzeff,[3] working under the direction of H. Kolbe, found that, if a mixture of hydrogen with nitrobenzol vapor be passed over finely divided palladium,[4] the nitrobenzol is converted into anilin, i.e., is reduced.[5] The palladium acts as a catalyst. Later Sabatier and his associates discovered that unsaturated organic compounds in general may be reduced, provided they may be vaporized without decomposition.[6] The great practical value of their discoveries lies in the demonstration that the expensive noble metals, palladium and platinum, are not essential catalysts for the reaction, and that certain cheap base metals (notably nickel, and also cobalt, copper, and iron when finely divided) are good catalysts at temperatures of 150° to 300° C.[7]

[1] *Chemical Technology . . . .*, III, 119 ff. and 244 ff.

[2] H. Debus, "Ueber die Darstellung des Methylamins aus Blausäure und Wasserstoff," *Annalen der Chemie*, Part 2, 1863, CXXVIII, 205.

[3] M. Saytzeff, "Ueber die Einwirkung des vom Palladium absorbirten Wasserstoffes auf einige organische Verbindungen," *Journal für praktische Chemie*, October 25, 1873, 2 Folge, VI, 128.

[4] Palladium is a noble metal, in some respects resembling platinum.

[5] The reaction is as follows:

$$\underset{\text{nitrobenzol}}{C_6H_5NO_2} + \underset{\text{hydrogen}}{3H_2} = \underset{\text{anilin}}{C_6H_5NH_2} + \underset{\text{water}}{2H_2O}$$

In the language of the chemists before the era of the electron theory, reduction is the removal of oxygen from a molecule or the addition of hydrogen, or (as in the foregoing case) both.

[6] French Patent No. 312,615 (1901); German Patent No. 139,457 (July 26, 1901). See *Chemisches Centralblatt*, April 21, 1897, I, 801; July 28, 1897, II, 257; June 28, 1899, I, 1270.

[7] Cf. P. Sabatier (translated by E. E. Reid), *Catalysis in Organic Chemistry* (New York, Van Nostrand, 1922). A German patent, No. 139,457 (July 26,

However, it was not feasible to use the process in its original form for the hydrogenation of liquid fatty acids and of oils, because these are not readily vaporized without decomposition, except under very special conditions. That hydrogenation can be effected in the liquid phase seems first to have been shown in the German patent of Herforder Maschinenfett- und Oelfabrik, Leprince and Siveke (German Patent No. 141,029 [August 14, 1902]), and the corresponding British patent of Wilhelm Normann (British Patent No. 1515 [November 26, 1903]).[1] According to these patents, the finely divided metal is mixed with the melted fatty acid or fat or oil, and hydrogen is then introduced into the mixture. The novelty of Normann's process as compared with those of Sabatier and Saytzeff consists in the carrying on of the reaction in the liquid state.

The first American patents seem to have been issued in 1912.

The title to the Normann patent soon passed to the English firm of Joseph Crosfield and Sons, Ltd., but was not used commercially for some time, since it required research and experimentation before methods were perfected for the preparation of an active nickel catalyzer and for the devising of suitable machinery with which to carry on the process. However, by 1906 or even earlier, the process was in use in Europe, and whale oil was already being hydrogenated for margarine. A large number of patents have been issued introducing a great variety of modifications and improvements;[2] and many theoretical papers have been published dealing with the scientific aspects of the reaction. Agreement has not yet been reached in regard to its exact nature, especially as concerns the manner of action of the catalysts.

Joseph Crosfield and Sons, Ltd., the owners of the Normann patents, offered the American rights to the American Cotton Oil Company, of which the N. K. Fairbank Company was a subsidiary. This company was interested because the patents made possible the production of an oleostearin substitute from vegetable oils. Mr. Boyce, chief chemist of the company, had been in Europe and

---

1901) to J. B. Senderens is probably the first patent record having anything to do with the reduction of organic substances by hydrogen in the presence of nickel catalysts. Cf. also P. Sabatier and J.-B. Senderens, "Nouvelles méthodes générales d'hydrogénation et de dédoublement moléculaire basées sur l'emploi des métaux divisés," *Annales de chimie et de physique*, March 1905, 8ème série, IV, 319.

[1] Details concerning the litigation involving these patents may be found in Ellis, *The Hydrogenation of Oils*, pp. 7–9 and Appendix A. Details regarding the polemic on the methods of producing the nickel catalyst may be found in Ellis, *Hydrogenation of Organic Substances . . . .*, chapter xii.

[2] For details, the reader is referred to Ellis, *The Hydrogenation of Oils* and *Hydrogenation of Organic Substances . . . .*

had investigated the process as it was in use there. However, the Crosfield patents ultimately were acquired by the Procter and Gamble Company of Cincinnati, soap-makers (Ivory soap). The rôle of this company in the American solid-cooking fat industry has been discussed in the main body of the text. At about the same time, David Wesson was experimenting on behalf of the Southern Cotton Oil Company, but, since it was necessary to develop a catalyzer that was not covered by patents, quantity production was not achieved till 1912 or 1913. Similarly, at this time, Hugh K. Moore developed a successful process for the Brown Company, of Berlin, New Hampshire, to enable this company to use waste hydrogen from the manufacture of chlorin and caustic soda.

In practice, the process involves three separate operations: the securing of hydrogen, the preparation of the catalyst, and the hydrogenation of the oil.

A pound of olein requires a little more than 0.1 ounce of hydrogen for its conversion into stearin. Since 1,000 cubic feet of hydrogen gas weigh about 5.6 pounds, a short ton of olein requires about 2,500 cubic feet of hydrogen. While only a small quantity of hydrogen by weight is necessary, the volume needed is considerable. Since different oils contain different proportions of olein and since many of them also contain more or less linolin and linolenin (see p. 231), different oils require different volumes of hydrogen. According to Linde, 6 to 10 cubic meters of hydrogen are required for hardening 100 kilograms of oil.[1] The hydrogen, moreover, must be quite pure, so that it may not poison the catalyst. Therefore, one of the chief problems of hydrogenation is to secure a cheap supply of pure hydrogen.

Two principal methods are in use: the steam-iron and the electrolytic process. In the former, steam is passed over hot iron, whereby the iron removes oxygen from the water, converting itself into oxid of iron, and sets hydrogen free. In the latter, an electric current is passed through water between two poles, whereby the water is decomposed into oxygen and hydrogen, one appearing at one pole, the other at the other, so that they may be collected separately. For details of the various processes, the reader is referred to the monograph of Ellis.

Hydrogen is also a joint product of a number of large-scale chemical manufacturing processes—notably the production of caustic soda and bleach by the electrolysis of brine. A considerable proportion of this hydrogen is now used for hydrogenations. The principal cost is its compression, storage, and transportation.

[1] F. Linde, "Production of Hydrogen," *Proceedings of the Third International Congress of Refrigeration* (Chicago, September 1913), II, 219.

The cylinders in which it is compressed are heavy and expensive, so that transportation for considerable distances is not feasible. Gas mains for hydrogen have not as yet been built in the United States.

The catalyst usually employed is nickel, but sometimes a combination of nickel with a small amount of a second metal, most commonly copper, is used. The second metal is known as a promoter. Since the effectiveness of such a catalyst as nickel is in part dependent upon the extent of the surface it exposes to the oil with which it is in contact, the methods of preparation aim to secure the catalyst in a state of fine subdivision. One way to accomplish this is to mix the compound of nickel from which the catalyst is prepared with a finely divided, fluffy or porous, inert substance. Such a substance is known as a carrier. The substance most often used is a diatomaceous earth, commonly known by its German name, *Kieselguhr.*

To prepare the catalyst, finely powdered nickel oxid, hydroxid, or carbonate is placed in a vessel through which a stream of hydrogen is passed. If a carrier is used, the nickel compound is first intimately mixed with the carrier. The vessel is then heated. Under the influence of heat and hydrogen, finely divided metallic nickel is formed, which, if a carrier has been used, is spread over the surface and in the pores of the carrier. The catalyst thus prepared is then added in suitable proportion (0.1 to 2 per cent of the oil) to the oil to be hydrogenated, care being taken to prevent contact with air during the transfer.

Instead of preparing the catalyst separately and then adding it to the oil to be hydrogenated, the catalyst may be prepared in the oil itself. A finely powdered salt of nickel, usually nickel formate, is suspended in oil and the suspension heated while a stream of hydrogen bubbles through. Since the temperature necessary is rather high, the oil may be scorched. This can be avoided by using a little copper with the nickel as promoter; a lower temperature is then adequate. For edible products, copper is objectionable because it is poisonous. Therefore, at least in America, when edible products are manufactured, instead of using copper, the nickel salt is suspended in a small volume of oil and heated. If the oil becomes scorched, the catalyst is filtered off, washed with a little fresh oil, and then added to the oil to be hydrogenated.

A small amount of catalyst, prepared in either way, is adequate for a large volume of oil, and it may be used repeatedly. Ultimately, it becomes inactive, so that, to hydrogenate further parcels of oil, fresh catalyst has to be used.

The hydrogenation, itself, is carried out as follows: A suit-

able quantity of catalyst, prepared in one way or another, is added to the oil, and the suspension heated in a closed vessel while a stream of hydrogen is bubbled through. For a number of fatty oils, the mean temperature of maximum velocity of saturation with hydrogen is about 180° C. or 356° F. When the reaction has proceeded to the desired point, the hydrogen stream is interrupted, the apparatus cooled, the oil withdrawn, and the suspended catalyst filtered off.

The rate of hydrogenation is influenced by the pressure of the hydrogen and the process is usually carried on at a pressure higher than that of the atmosphere (20 to 150+ pounds). The rate is also affected by stirring and the apparatus is, therefore, sometimes equipped with devices to agitate the liquid.

Impurities present in the fat or oil to be hydrogenated may create difficulties, because they interfere with the action of the catalyst. The chemist speaks of this as poisoning of the catalyst. Thus, rape oil contains a substance that poisons the catalyst, and certain marine oils also contain interfering substances. To obviate such poisoning of the catalyst, oils are carefully refined, but other methods may be used.[1] Refining is especially important, if the oil contains considerable quantities of free fatty acids, for, unless the oil be neutral, there is some combination between the nickel and the acid. The resulting nickel soap contaminates the final product. It is, therefore, desirable for the oil to be neutral. This can be attained not merely by refining, but also by converting the free fatty acid present in the oil into a glycerid or other ester. This may be accomplished by adding glycerol, mono- or diglycerids, or alcohol to the oil and heating. It should be noted, as pointed out below, that thus the refining loss is avoided, glycerid is synthesized, and (theoretically) the final yield of hardened oil is materially increased.

While hydrogenation changes the consistency of oils and fats, making them more or less hard according to the degree of hydrogenation, it affects them also in other ways. Rancid fats tend to lose much of their evil odor and flavor when completely hydrogenated; moreover, hydrogenation reduces the tendency of fats to turn rancid. In the language of the oil technologist, they become more stable. While the mechanism by which a fat becomes rancid is not fully understood, it seems certain that oxidation is an important factor. Practically all vegetable oils contain not merely the unsaturated glycerid, olein, which does not readily absorb oxygen at ordinary temperatures, but also glycerids of a lower degree of saturation, which readily absorb oxygen. The

[1] Ellis, *Hydrogenation of Organic Substances . . . .*, 47.

most oxidizable of these glycerids are those that contain linolic and linolenic acids. Since these glycerids are the first to be attacked by hydrogen and converted into less unsaturated glycerids, hydrogenation, even if not carried to completion, counteracts oxidation and, therefore, improves the keeping qualities of the oil. A further factor favoring rancidity is the presence in the oil of decomposible organic substances (aldehydes, ketones, and hydroxy fats). These seem to be removed by hydrogenation.[1]

Hydrogenation destroys the characteristic aroma of different fats. They become bland and tasteless, or acquire a slight tallowy flavor. Coconut oil, however, which is without distinctive flavor, is said to be much improved in this regard by hydrogenation through the acquisition of an aroma suggestive of butter. Many of the fats are so changed by hydrogenation that they no longer give the chemical reactions which are commonly used to detect their presence. Thus, cottonseed oil after hydrogenation no longer gives the reactions of Halphen[2] or of Bechi.

Furthermore, it is reported that hardened fats can hold much more water than their unhydrogenated counterparts and may, therefore, be used to advantage in margarine.[3] Clayton did not find excessive moisture content in margarine of British manufacture.[4] However, this is a matter of but slight importance in the United States, where the moisture content of both butter and margarine is limited by governmental regulation to 16 per cent.

By varying the amount of catalyst or its character, the temperature, the pressure, and the degree of hydrogenation, rather different products are obtained. Many oils, for example cottonseed oil, consist largely, perhaps wholly, of mixed rather than simple glycerids. Theoretically, eighteen mixed glycerids are possible in cottonseed oil. How many of them and which ones actually occur is not known, since satisfactory methods adequate for their separation have not yet been worked out. However, since cottonseed oil is so complex a mixture, it is obvious that even slight variations in the conditions of hydrogenation must produce

[1] Cf. U.S. Patent No. 1,605,108 (November 2, 1926) of G. Grindrod.

[2] This reaction, which makes the detection of cottonseed and kapokseed oil easy, was discovered in 1897 (G. Halphen, "Réaction caractéristique de l'huile de coton," *Journal de pharmacie et de chimie*, 1897, Sixième Série, VI, 390).

[3] K. Brauer, "Über das Wasserbindungsvermögen von gehärteten Fetten und der Wassergehalt daraus hergestellter Margarine," *Zeitschrift für öffentliche Chemie*, July 30, 1916, XXII, 209; abstract in *Chemical Abstracts*, June 10, 1917, XI, 1699, and *Zeitschrift für angewandte Chemie*, November 24, 1916, Vol. XXIX, Part 2, p. 492.

[4] W. Clayton, "Modern Margarine Technology," *Journal of the Society of Chemical Industry*, December 15, 1917, XXXVI, 1206.

variations in the product. Hence, it is not at all astonishing that many anomalies are met in melting-points and iodin number in hydrogenated products like vegetable shortenings.[1] From the beginning of hydrogenation of cottonseed oil, the linolin decreases while the stearin increases. Olein rises to a maximum and then continuously decreases. These changes are due to the fact that hydrogenation forms olein from linolin more rapidly than it forms stearin from olein. The rates of the two reactions are affected differently by the conditions of hydrogenation with resultant variation in the product. For example, raising the temperature speeds up the rate of hydrogenation of both linolin and olein; but the linolin rate is raised more than the olein rate. Hence, high temperatures produce a product high in olein, provided, of course, the reaction is interrupted at the proper point.[2]

Finally, it is to be noted that hydrogenation produces changes in unsaturated glycerids other than the mere addition of hydrogen. Iso-oleic acid is formed. This is a solid. A large volume of research has been published on this acid, but no final conclusion has been reached concerning its nature. It seems probable that it is a mixture of acids closely resembling oleic acid, but differing from ordinary oleic acid in the position in the molecule of the point of unsaturation. There is also reason to believe that a high temperature and long operating time favor the formation of iso-oleic acid.

Though refined vegetable oils as a rule do not contain vitamins, certain animal fats do, and the effect of hydrogenation upon their vitamin content is therefore of interest. Though commercially hardened oils seem to lose their vitamins, there is some reason to believe that this is not the result of the hydrogenation *as such*, but of the high temperature and of oxidation.[3] Evans and Burr have found that wheat-germ oil may be hydrogenated without loss of vitamin E.[4] Dubin and Funk have reported that vita-

[1] Cf. David Wesson, "The Glycerides of Cottonseed Oil," *Cotton Oil Press*, November 1919, III, No. 7, pp. 34–35.

[2] Cf. H. K. Moore, G. A. Richter and W. B. Van Arsdel, "The Incomplete Hydrogenation of Cottonseed Oil," *Journal of Industrial and Engineering Chemistry*, May 1917, IX, 451.

[3] S. S. Zilva, "The Stability of the Vitamin A of Cod-Liver Oil Towards the Hardening Process," *Biochemical Journal*, 1924, XVIII, No. 5, p. 881. C. Funk and H. E. Dubin (U.S. Patent No. 1,629,074 [May 17, 1927]) heat codliver oil with glacial acetic acid under reflux for one hour without substantially impairing the vitamin efficiency. According to U.S. Patent No. 1,649,520 (November 5, 1927), these chemists concentrate vitamins A and D from codliver oil by hydrogenating at the low temperature of 60° C. and then extracting the vitamins from the solid fat.

[4] H. M. Evans and G. O. Burr, "The Anti-Sterility Vitamine Fat Soluble E," *Proceedings of the National Academy of Sciences of the United States of America*, June 15, 1925, XI, 339.

mins A and D are unaffected by hydrogenation.[1] They have based a method of concentrating the vitamins of codliver oil upon these observations.[2] However, Nakamiya and Kawakami have reported that "biosterin" (vitamin A?) is destroyed.[3] Sumi found that hydrogenation destroys the antirachitic properties of irradiated ergosterol, while Ueno, Yamashita, Ota, and Okamura were able to hydrogenate various oils without affecting their vitamin content.[4] On the contrary, some of the hardened oils gave rather better results than the unhardened, a fact that these Japanese investigators attribute to their greater stability and the elimination by the chemical treatment of toxic substances. It would seem, therefore, that while commercially hydrogenated oils lose their vitamin activity, this may be retained, if the process is conducted in special ways.

Hydrogenated vegetable shortening may be produced in either of two ways, and the resulting products have somewhat different properties: (1) The whole batch of oil may be hardened to the desired consistency, usually that of lard, and the catalyst then removed. (2) A portion of the oil is more or less completely hydrogenated. This is then melted together with varying volumes of unhardened oil and the mixture cooled on a lard roll. The proportion of hardened oil used varies with its hardness and with the consistency desired—commonly from 7 to 10 per cent of the hardened oil is employed.

Compound of the second type is said to be cheaper to manufacture, and production more flexible. The quantity of the first type that can be produced daily is a function of the hydrogenating capacity of the plant. The second type may be made by a concern that has no hydrogenating plant of its own, but buys fully hydrogenated oil and blends it with unhydrogenated oil. A concern with hydrogenating facilities may meet a peak demand with a smaller plant by hydrogenating some oil completely during periods of slack demand against the time of heavy demand. The amount of capital that it has to lock up in this way by manufacturing for stock is very much less than it would be if the first type

[1] H. Dubin and C. Funk, "Studies on the Chemistry of Cod Liver Oil," *Proceedings of the Society for Experimental Biology and Medicine*, 1923, XXI, 139.

[2] U.S. Patent No. 1,649,520 (November 15, 1927).

[3] Z. Nakamiya and K. Kawakami, "On the Hydrogenation of 'Biosterin'," *Scientific Papers of the Institute of Physical and Chemical Research* (*Tokyo*), October 20, 1927, VII, 121.

[4] S. Ueno, M. Yamashita, Y. Ota, and Z. Okamura, "On the Nutritive Value of Hydrogenated Oils," *Journal of the Society of Chemical Industry* (*Japan*), June 1927, Vol. XXX, No. 6, p. 378; Abstracts from the original communications, Supplemental Binding, p. 105B.

were manufactured for stock, for only a minor portion of the oil required for the finished product has to be hydrogenated and stored.

The two types of compound differ in properties. The second type retains the flavor of the unhydrogenated oil, which is sometimes desirable. However, as is evident from the method of manufacture, the product contains all of the unsaturated glycerids characteristic of the unhydrogenated oil present; therefore this kind of vegetable shortening is less stable, and keeps less well than the first type. This is a matter of great importance, if it is to be used in food products like crackers, biscuits, and confectionery that may not be consumed for some time after they have been finished. The differences in behavior of the two types of product when used for shortening and other culinary purposes will be discussed in Appendix C.

Since the granting of the Normann patents, there have been issued a large number of patents for the manufacture of solid or semi-solid cooking fats. One of these (U.S. Patent No. 1,135,351, issued to Burchanal on April 13, 1915) was involved in the litigation of Procter and Gamble Company *vs.* Berlin Mills Company. That litigation attracted wide attention because, had the Procter and Gamble Company prevailed, the manufacture of lard-like fats from oil might have been monopolized for the life of the patent. There can be no doubt that this litigation frightened off certain concerns for a time, and thus delayed the spread of hydrogenation in compound manufacture.

Another patent is interesting because it involves pressing.[1] The oil is hardened more than required and then pressed to remove some of the harder material. It is stated that in this way the unstable glycerids of linoleic and linolenic acids are better hydrogenated than by the customary process.

Taking the patents of recent decades as a whole, however, they present little that is fundamentally new; they deal primarily with the restriction of the degree of hydrogenation in special ways, with special formulas for making suitable mixtures of fats and oils, or with modifications of the hydrogenation process. Some deal with methods to improve texture and appearance, such as chilling, emulsification, or beating in air. Others deal with machinery or equipment used in the manufacturing processes.

An interesting possibility to thicken oils is suggested by British Patent No. 187,298 (July 12, 1921), issued to E. V. Schou. A drying or semidrying oil is polymerized, by heating or oxidation or both, until it has a gelatinous consistency. The thickened prod-

[1] Carleton Ellis, U.S. Patent No. 1,058,738 (April 15, 1913).

uct is then added to oils and fats to increase their viscosity. Little seems to be known concerning the digestibility of polymerized and oxidized oils. Other patents involve formation of a stiff emulsion in water with the aid of soap, or the admixture of such stiffening agents as waxes, mucilaginous and gelatinous substances. It is doubtful that any of these products could be classed legally as compound.

Finally, attention may be drawn to the possibility of hardening fats not by hydrogenation but by synthesis of triglycerids. Thus, on August 15, 1924, U.S. Patent No. 1,505,560 was issued to Adolf Grün of Czechoslovakia, which proposes, as a first step, to convert fats into mono- or diglycerids by heating with glycerin in the presence of an esterifying catalyst. As the final step, it is proposed to convert these mono- and diglycerids into new triglycerids by heating with free fatty acids. It is obvious that by this method the consistency of a fat might be raised or lowered according to the character of the free fatty acid used in the final step. If a solid acid like stearic acid be used, the final fat would be harder. The writers do not know whether the process is actually in commercial practice.

The process mentioned above (p. 269) of preventing poisoning of the catalyst by the free fatty acid present in the oil through heating with glycerin[1] or through the addition of mono- or diglycerids[2] involves a similar principle. If the mono- or diglycerid added according to Bolton and Lush contain high-melting acids, like stearic acid, the melting-point of the product would be raised even without hydrogenation.

United States Patent No. 1,547,571, issued to Ellis on July 28, 1925, is also based on synthesis. Stearic acid is heated with glycerin to form the diglycerid. This hard synthetic diglycerid is then blended with oil in suitable proportion to obtain the desired consistency. The writers do not know whether the process has had commercial application. The synthesis is conducted essentially according to the old method of Berthelot. According to the experience of one of the writers, this method is by no means simple, at least on a laboratory scale.

[1] U.S. Patents No. 1,261,911 (April 9, 1918), No. 1,271,575 (July 9, 1918), and No. 1,271,567 (July 9, 1918), issued to Ellis.

[2] British Patent No. 162,382 (January 27, 1920), issued to Bolton and Lush.

APPENDIX C

METHOD OF ACTION OF SHORTENINGS

Introduction

In the body of the text, reference is frequently made to the properties of fats as determining their special food uses, but why these properties determine such uses is not there made clear; to have treated this subject adequately would have interrupted the argument unduly. The purpose of this appendix is to supply this information with reference to frying fats and shortenings. Other uses of fats are not considered. Unfortunately, many of the principles underlying the operations of the kitchen and the bakery have not been sufficiently studied scientifically; therefore, the material presented in this appendix, all of which is drawn from the literature, is imperfect and incomplete. The attempt is made to present an outline of the conclusions concerning the methods of shortening action that may be reached through a critical analysis of existing American literature. The literature itself is not discussed in detail, for such a discussion would be out of place in an economic study. A critical detailed analysis of the literature will be presented in another publication.

Shortening

Definition of shortening power.—A dictionary definition of shortening is: "Material, as lard or butter, used to make pastry crisp." Davis[1] defines the property of shortness in the following terms: "That cake which requires the least load to measure its breaking strength is the shortest, that which requires the heaviest load is the least short. The best shortening is that material which when baked in a dough gives to the product a minimum breaking strength and a minimum crushing strength." It is obvious that this definition of shortness and shortening power assumes that shortening has but one action, namely to produce minimum crushing strength. However, shortening may have other effects, such as to impart a flavor, flakiness, or uniformity of texture to

[1] C. E. Davis, "Shortening: Its Definition and Measurement," *Journal of Industrial and Engineering Chemistry*, September 1921, XIII, 797.

the baked goods, or a special color or consistency to the crust. In bread, the rôle of shortening is certainly not to give minimum crushing strength. The definitions of shortening above given, therefore, seem to the writers too limited in scope.

It is doubtful that it is possible to give a general definition of shortening power sufficiently inclusive to cover all the effects of shortenings in the several sorts of shortened baked products. Baked goods represent a series of products characterized by different shortening content; at one extreme is bread containing little or no shortening, and at the other, products like puff pastry containing much. In between lies a series ranging from batters in which the shortening is introduced in the fluid state, for example popovers and griddle cakes, through crackers, biscuits, cookies, cakes, and plain pastry. In the various products, the effects desired are somewhat different, and it is an open question whether these various effects are all comparable qualitatively or quantitatively.

The writers believe it remains to be proved that the fundamental principles of the action of fats in baked goods are always the same; they believe no general definition for shortening power can be given. One can define it only, they believe, for a given class of products, by describing its effect in these products. It is as yet quite impossible to offer a general definition appropriate for all products; perhaps, no such definition will ever be possible, since shortenings are valued for different purposes in different products, and since their effects upon the finished product depend not merely upon the properties of the shortening itself, but also upon the manner in which it is incorporated in the dough or batter. The temperature of the water and its proportionate amount, the proportion of sugar, the temperature of the shortening itself, the physical manner in which it is incorporated in the dough, the way in which the dough is mixed or otherwise treated mechanically, the nature of the leavening agent, the oven temperature—all these, at least, contribute to the properties of the finished product.

Perhaps, in the present state of our knowledge, the only practical way to evaluate and compare different fats in respect to shortening power would be to establish some sort of score-card system in which different properties of the shortening would be given different weightings according to their importance. Possibly, it would be necessary to have a different set of weightings for each class of baked products.

The properties of fats and oils of greatest importance in shortening.—The properties of fats and oils that, aside from flavor and price, are most important for shortening purposes

are stability, feel in the mouth, consistency, and creaming power.

By stability is meant the property of not turning rancid. The importance of stability is related to flavor, for, if an unstable fat is used, the product sooner or later acquires a rancid flavor.

The feel in the mouth and the way in which a food chews is a property only in part distinguished from flavor. It, as well as flavor, is one of the factors that gives a food a desirable taste. The feel in the mouth is largely a matter of texture, and, since shortenings markedly affect texture, they determine to that extent the feel in the mouth. A shortening should not give the product in which it is incorporated a greasy or slimy feel when it is chewed. It is said that coconut oil, either as such or as margarine, gives less of this objectionable feel than most other fats, especially in articles with a very high shortening content.

The consistency of a fat is important, for it determines the manner in which it becomes distributed through the dough or batter. If a fat is very hard, that is, has a high melting-point, it is difficult to distribute it through the dough. If it is very soft or liquid, that is, has a low melting-point, it may tend to run out of the product and give it a greasy appearance and feel.

By creaming power is meant the ability of a fat, when beaten either by itself or with other substances, especially sugar, to hold air bubbles, increase greatly in volume, and acquire a smooth, plastic texture. It is not known definitely what determines creaming power. It seems generally admitted that lard does not cream well, whereas hydrogenated fats do. Other forms of compound and also butter cream fairly well. Coconut oil, especially the preparations of it which are known in the trade as coconut butters, cream quite well; they are used rather for fillings and icings than for shortenings.

Method of Action of Shortening

While the effects desired in the use of shortening vary widely, one fact seems fairly well established: It is that the action of all shortenings is primarily physical or mechanical. If this were not so, then petrolatum, a petroleum product that, chemically speaking, is exceedingly inert, would be quite devoid of shortening power. It is, in fact, not at all a poor shortening.

The mechanical effect of shortening fats is exercised by virtue of the formation of films around the particles of the dough or batter. These films are not wetted by and do not mix with water. They create surfaces of structural weakness within the baked product, so that it crumbles, flakes, or tears easily.

Flour is composed principally of two constituents, starch and gluten. Both starch and gluten are easily wetted by water, and both absorb considerable of it. The properties of starch are hardly changed thereby; gluten, however, swells greatly and becomes sticky, gummy, and elastic. In that state, the different particles of flour stick together to form an elastic network holding in its meshes starch granules and other components of the flour. This conversion of dry gluten, as it exists in flour, into the sticky elastic state in which it exists in dough is known as the development of the gluten. If fat is one of the constituents in preparing dough or batter, more or fewer of the gluten particles of the flour are covered by a film of fat. They are more or less sealed off, so that water has less ready access to them than it would have with no added fat present. The result is that the gluten is able to absorb less water and develop less perfectly. In consequence, the dough is less sticky, elastic, and tenacious than it would otherwise be. This lack of tensile strength carries over into the finished baked article, so that it is shorter than it would be had no fat been used in its preparation. The degree of shortness depends upon the amount of fat present and upon the manner of its distribution. If it is very uniformly distributed, so that very many of the gluten particles have been coated with it, the product tends to be crumbly and tender. If the distribution is not so fine, and especially if the distribution is in thin layers, as in certain types of pie crust, the product tends to be flaky. Whether or not it is desirable to distribute the shortening through doughs and batters as perfectly as possible depends upon the texture that it is desired to produce.

Correlation of Flour Quality and Shortening Effect

The amount of shortening that is necessary to produce a given effect depends not merely on the factors above discussed, but also upon the nature of the flour. It has been well established that standard cookies, varying solely in the kind of flour used, that is with constant shortening content and using the same shortening, range in order of shortness from shortest to least short in the following series: soft winter, medium winter, strong winter, spring. Since shortening as a rule is the most expensive ingredient, the use of soft flours is economical in certain cases. The fact that, to secure a product of given shortness, weak flours require less shortening than strong ones is possibly one of the reasons why soft flours are preferred for short baked products.

The Effect of Shortening upon the Leavening Process

There is no evidence that shortening has any notable effect upon leavening by yeast fermentation or by baking powders as such. It has, however, certain apparent effects. According to American experience, bread dough rises faster and comes to the first punch earlier when shortening has been used than when it is absent. Furthermore, the presence of shortening greatly improves the texture and affects the spring in the oven. This is especially true for cakes made without yeast or baking powder. In these articles, the leavening effect is produced by creaming the shortening before the other ingredients are combined with it. The result is that the dough or batter, as it goes into the oven, has distributed through it a multitude of fine air bubbles, which cause the final porous texture of the baked article.

It is not easy to explain how the shortening acts in all these cases. The most probable hypothesis seems to the writers to be the following: The shortening tends to form through the dough or batter what might be likened to membranes or partitions of fat, that may be very thin, but are, nevertheless, impervious to air, carbon dioxid gas, and water vapor. The result is that, in yeast fermentation of dough, the carbon dioxid generated encounters barriers to its diffusion through and escape from the surface of the dough. In consequence, the dough rises faster in the beginning of the fermentation. Later, when these products, whether bread or cake, are brought into the oven, the fat still acts as a brake on the diffusion of gas and water vapor to the surface, so that the spring in the oven is increased and the shrinkage from evaporation of moisture reduced. This, however, is merely an hypothesis that still awaits the final test of experiment.

Effect of Shortening on the Onset of Staleness

Perhaps the hypothesis above advanced explains why shortening seems to reduce the loss in weight during the first few hours after the baked product comes from the oven. The fat hampers the diffusion of water vapor to the surface of the loaf and therefore there is less loss of water by evaporation. The hypothesis may also have a bearing on the indubitable fact that the presence of shortening delays the onset of staleness, especially in bread. Unfortunately, there is no satisfactory theory of the process of growing stale. It is certain that the loss of moisture is not the cause or even an important factor. It is, therefore, impossible at present to say how the presence of shortening delays the onset of staleness, or even to offer a plausible hypothesis.

The Measurement of Shortening Power

So far as shortenings are tested at all, only two non-chemical tests are made: creaming power and power to produce a product of minimum breaking and crushing strength. The most important instrument to determine the crushing strength is the shortometer of Davis.[1] This is a simple mechanical device, patterned after cement-testing machines, to measure the force required to break or crush a standard cookie. To determine breaking strength, such a cookie is laid upon two metal rails so that it is unsupported between them. Weights are then placed upon the unsupported section between the two rails, and these weights are increased till the load is great enough to break the cookie. The weight just heavy enough to break the cookie is regarded as the measure or index of the shortening power of the fat or oil used in making the cookie. The shortening power of different fats is assumed to be inversely proportional to the breaking weight. The less the weight required to break the cookie, other things being equal, the shorter the cookie. To test crushing strength, the procedure is the same, except that the two rails are removed and the cookie is placed flat upon the table of the instrument.

Baking technologists differ regarding the value of this method of testing shortening power, but nearly all the quantitative information we have concerning the relative shortening power of different fats has been obtained with the shortometer. Only experiments on the breaking strength of standard cookies are on record in the technical literature. There is no record of the investigation of the resistance of cookies to crushing.

Davis, on the basis of his shortometer tests, evaluates shortenings as follows. "Lard, which has the greatest shortening power, naturally comes first. Compounds rank next, and they have about the same shortening power if they are made by adding oil to animal stearin or to vegetable stearin—namely hydrogenated vegetable oil. Butter fat follows next in order. The oils—cottonseed, peanut, olive, rapeseed, soy bean, and corn—all have approximately the same shortening value, which is about three-fourths of the value of ordinary lard.

"Coconut oil is somewhat lower than the previous group of oils and has about two-thirds of the value of lard. Coconut oil if broken up into olein and stearin fractions shows a value higher than whole coconut oil for stearin, and lower for olein. . . . . A liquid paraffin oil with an iodine number of 0.4 has a shortening value very close to that of coconut oil. A sample of white vaseline

[1] Davis, *op. cit.;* also U.S. Patent No. 1,458,130 (June 12, 1923).

had a shortening value fully as good as the ordinary oils, or 75 per cent of that of lard." Davis, furthermore, found that hydrogenation increased the shortening value of an oil.[1]

Platt[2] and Platt and Fleming[3] range shortenings in the following order: lard, lard compound, cottonseed oil, butter, coconut oil, vaseline, and liquid paraffin oil (Nujol).

Putland and Wall,[4] testing products with a higher shortening content than those tested by Davis and by Platt and Fleming, found the following order of shortening power: all-hydrogenated shortening, vegetable compound, oil, pure lard, butter.

No serious attempt seems to have been made to develop an exact method to measure creaming power. The only method in use seems to be the service test. The desired mix is made, thrown into a high-speed mixer, the motor started, the maximum volume to which the mix is beaten up noted, the mixing continued to note to what extent the volume remains large or decreases. Shortenings cannot stand unlimited time of creaming.

As above indicated, the consistency of a fat is of considerable importance. For certain flaky products, like puff paste, plastic fats are generally preferred. Much has been written concerning the plasticity of shortening, but very few exact measurements have been made. Although it is possible to measure plasticity with great exactness, this method of evaluating shortenings is rarely resorted to.

Choice of Shortening

By this time it must be clear to the reader that, since the testing of shortenings is as yet far from exact, the choice of shortenings in practice can hardly be made on a scientific basis. Choice is largely based upon rule-of-thumb, practical experience, tradition, and custom. To a not inconsiderable extent, choice is personal on the part of the master baker. In consequence, what is presented in this section is based on existing practice rather than on scientific principles.

[1] Davis, *op. cit.;* and letter to the editor, *Industrial and Engineering Chemistry,* October 1923, XV, 1089.

[2] W. Platt, "Shortening in Sweet Doughs," *Baking Technology,* July 1923, II, 216.

[3] W. Platt and R. S. Fleming, "The Action of Shortening in the Light of the Newer Theories of Surface Phenomena," *Industrial and Engineering Chemistry,* April 1923, XV, 390.

[4] A. W. Putland and H. Wall, "Variations in Shortening Power of Some Oils and Fats," *Cracker Baker,* February 1929, XVIII, 41.

Since shortenings, as we have seen, are used to bring about quite different effects in different products, it is obvious that the choice of a shortening, aside from considerations of costs, is largely governed by the nature of the product for which it is to be used. The only considerations that are common to the selection of shortenings for all products are flavor and stability. For this reason, butter is widely used in many products, even though it contains but 80 to 85 per cent of fat and is inferior in creaming and shortening power to many other fats.[1] Sometimes butter is mixed with other cheaper fats, so as to get the butter flavor combined with the desirable properties of the other fats.[2] Shortening used in this way should be quite bland, for a small amount of strongly flavored shortening may cover up the flavor of good butter. Unripened sweet cream butter is well-nigh useless for making such a combination, for it imparts little or no butter flavor. The butter should be made with a starter.[3] Most commercial bakers do not use the highest-score butter even for quality goods, since it is less strongly flavored than butter of somewhat lower score. Butter scoring 89 or 90 is most commonly used. While some bakers still regard butter as the ideal shortening for cakes, its yellow color is objectionable for white cakes. A white shortening is then necessary, usually some kind of vegetable shortening. In Europe, margarine is second choice to butter for flavor, but in America it is not in general use.

Many American bakers prefer lard for bread, because of its flavor. Some cereal chemists, while admitting its favorable influence on flavor, say that if a shortening such as lard is used in bread the flavor as such does not carry through into the finished baked loaf but nevertheless improves the flavor of the finished loaf. For some consumers and for some products, such flavor as is contributed by lard to other baked products is undesirable, and under such circumstances quite bland products like some vegetable shortenings are preferred.

For cakes and similar products in which the shortening is customarily creamed with sugar, hydrogenated products are very largely used. Lard is less used because it does not cream well, and butter, because it is expensive. In Europe, margarine is used to a very large extent. In the last few years, packers have modified lard by refining and partial hydrogenation, so that it may be

[1] J. Stewart, "The Making of Slab Cakes," *British Baker*, December 14, 1928, LXVIII, 17.

[2] *Idem;* D. M. Hopkins, "Progress of Cake Baking. The Top Is the Last to Bake," *Bakers' Helper*, December 21, 1929, LII, 1594.

[3] C. L. Brooke, "The Vanilla Wafer," *Cracker Baker*, December 1927, XVI, 59.

used like hydrogenated shortening. These modified lards have been on the market so short a time that it is uncertain, as yet, what favor they will find among commercial cake bakers.

For pies, a considerable variety of shortening is used. The preferred shortening is apparently lard, although vegetable shortenings are also widely used.

For bread, as above stated, lard is widely used, but vegetable shortening and vegetable oils, like cottonseed oil, are also employed.

TRADE-MARKS OF COMPOUNDED COOKING FATS REGIS

For whom registered	Year	Title (and/or picture)
Hannah E. Kriel, Baltimore, Md.	1918	White Oak
N. K. Fairbank Co., Chicago	1906	Fairbank's
John Hobbs, Boston	1874	Cream-Suet
Christr. Thomas & Bros., Ltd., Bristol, England	1900	(Assyrian bull)
Miami Oil and Soap Works, Cincinnati	1881	Cookolene
W. Butcher's Sons, Philadelphia	1882	Olive Butter
W. Butcher's Sons, Philadelphia	1882	Olivene
W. Butcher's Sons, Philadelphia	1882	(Olive)
S. H. Cochran, Everett, Mass.	1882	Purola
W. Butcher's Sons, Philadelphia	1882	(Olive gatherer)
W. Butcher's Sons, Philadelphia	1882	(Olive branch)
N. K. Fairbank Co., Chicago	1915	Snow White
N. K. Fairbank Co., Chicago	1912	Victoria
N. K. Fairbank Co., Chicago	1887	Cottolene
N. K. Fairbank Co., Chicago	1906	Cottolene
Cotton Oil Product Co., New York	1889	C.O.P. (Chef and pig)
N. K. Fairbank Co., Chicago	1901	(Wreath of sprigs and blossoms)
N. K. Fairbank Co., Chicago	1906	(Bovine's head partially inclosed by a wreath of sprigs and blossoms)
N. K. Fairbank Co., Chicago	1903	(Bovine's head partially inclosed by a wreath of sprigs and blossoms)
N. K. Fairbank Co., Chicago	1906	(Two sprays, presumably cotton)
N. K. Fairbank Co., Chicago	1906	(Steer's head)
N. K. Fairbank Co., Chicago	1889	Golden Cottolene
George C. Napheys & Son, Philadelphia	1895	Royal
Armstrong Packing Co., Dallas, Tex.	1917	Bird (Plover in a circle)
W. J. Wilcox Lard and Refining Co., Guttenberg, N.J., and New York, N.Y.	1892	La Inmejorable [unimprovable]
Anglo-American Provision Co., Chicago	1894	Royal Brand (Fleur de lis)
Anglo-American Provision Co., Chicago	1895	Royal Lily

* Compiled from Patent Office records and from the *Patent Gazette*. This list may include a few liquid cooking fats, for the description of articles has not always been full enough to permit one to distinguish with certainty liquid cooking fats from compounds as we have interpreted the term.

D

TERED IN THE UNITED STATES PATENT OFFICE, TO 1930*

Use begun	Character of article	Number
.... 1820[a]	Lard substitute composed of cottonseed oil and other ingredients	123,826
.... 1868	Lard and lard compound	49,694
.... 1873	Tallow compounds[b]	1,842
.... 1873	Edible fats	34,195
Aug. 1881	Culinary oil	8,917
Feb. 1882	Substitute for lard	9,524
Feb. 1882	Substitute for lard	9,525
Feb. 1882	Substitute for lard	9,814
May 1882	Compound to be used in place of butter and lard for cooking purposes	9,565
July 1882	Substitute for lard and butter	9,815
July 1882	Substitute for lard and butter	9,816
May 1884	Cooking compound containing cottonseed oil and oleostearin	102,744
Mar. 1886	Cooking compound containing cottonseed oil and oleostearin	86,045
July 1887	Fatty, oleaginous, or unctuous food substances	14,808
July 1887	Prepared fatty, oleaginous, or unctuous food substances	52,787
June 1888	Cottonseed lard	16,549
July 1888	Prepared fatty, oleaginous, or unctuous food products	37,425
July 1888	Prepared fatty, oleaginous, or unctuous food substances	39,673
July 1888	Prepared fatty, oleaginous, or unctuous food substances	50,430
July 1888	Prepared fatty, oleaginous, or unctuous food substances	55,216
July 1888	Prepared fatty, oleaginous, or unctuous food substances	58,985
Aug. 1888	Oleaginous food substances	16,201
Sept. 1889	Lard and lard compounds and substitutes	26,373
.... 1889	Shortening composed of cottonseed oil and oleostearin	118,485
Nov. 1891	Lard and its substitutes	21,440
Jan. 1892	Lard compound	24,820
Jan. 1892	Lard compound	25,947

[a] The date is uncertain.

[b] Contents not stated: "used instead of butter, to shorten and enrich biscuits and other products of cookery."

[c] Applicant is owner of registered trade-mark No. 11,773.

TRADE-MARKS OF COMPOUNDE

For whom registered	Year	Title (and/or picture)
W. J. Wilcox Lard and Refining Co., Guttenberg, N.J., and New York, N.Y. . . .	1892	Rosalinda (Two moss roses an twig) . . . .
Robert B. Brown, New York	1892	Suetine . . . .
Cudahy Packing Co., Chicago and Los Angeles	1907	Suetene . . . .
N. K. Fairbank Co., Chicago	1893	Golden Cottolene, etc. . . . .
W. J. Wilcox Lard and Refining Co., Guttenberg, N.J., and New York, N.Y. . . .	1892	Canario (Canary) . . . .
W. J. Wilcox Lard and Refining Co., Guttenberg, N.J., and New York, N.Y. . . .	1892	Colibri (Humming bird) . . . . . .
W. J. Wilcox Lard and Refining Co., Guttenberg, N.J., and New York, N.Y. . . .	1892	Los Tres Castillos (Three castles
W. J. Wilcox Lard and Refining Co., Guttenberg, N.J., and New York, N.Y. . . .	1892	La Puertoriquena . . . .
W. J. Wilcox Lard and Refining Co., Guttenberg, N.J., and New York, N.Y. . . .	1892	El Clavel (Pink and bud) . . . . .
Samuel H. Read, New Haven, Conn.	1892	Lardene (inclosed in a diamond shaped panel) . . . .
Samuel H. Read, New Haven, Conn.	1906	Lardene (inclosed in a diamond shaped panel) . . . .
W. J. Wilcox Lard and Refining Co., Guttenberg, N.J., and New York, N.Y. . . .	1892	Columbus (Portrait) . . . .
T. M. Sinclair & Co., Ltd., Cedar Rapids, Ia.	1904	Palm Leaf (Palm leaf) . . . .
Anglo-American Provision Co., Chicago.	1893	Fowler Bros. Neutraline . . . . . .
Swift & Co., Chicago	1893	Cotosuet . . . .
W. J. Wilcox Lard and Refining Co., Guttenberg, N.J., and New York, N.Y. . . .	1893	El Libertador (Bolivar's head) .
Armour & Co., Chicago	1893	Vegetole . . . .
Shipton Green, New York	1894	Tropical . . . .
Parker, Webb & Co., Detroit	1893	Golden Shortening . . . .
Anglo-American Provision Co., Chicago.	1893	La Palma (Palm tree) . . . .
Nelson Morris & Co., Chicago	1894	Supreme Shortening . . . .
Fowler Bros. Ltd., New York and Chicago	1895	Acme . . . .
Swift & Co., Chicago	1915	Crescent (Crescent and star) . .
Loders & Nucoline, Ltd., Silvertown, England	1903	Nucoline . . . .
George Fowler, Son & Co., Ltd., Kansas City, Kan.	1894	Three Stars (Three stars) . . . . .
Filbert Manufacturing Co., Baltimore . .	1895	Oxola . . . .
Oxola Manufacturing Co., Baltimore	1914	Oxola . . . .
Minnesota Packing and Provision Co., South St. Paul, Minn.	1895	Crystal . . . .

[a] Used by predecessor since December 1894 and registered in 1895 under No. 26,14

COOKING FATS (*Cont.*)

Use begun	Character of article	Number
Feb. 1892	Lard and its substitutes	21,441
Feb. 1892	Compound of suet or beef fat and cottonseed oil for cooking purposes	20,944
Feb. 1892	Lard substitute	64,962
Feb. 1892	Oleaginous food substances	23,697
Mar. 1892	Lard and its substitutes	21,438
Mar. 1892	Lard and its substitutes	21,439
July 1892	Lard and its substitutes	21,603
July 1892	Lard and its substitutes	21,675
July 1892	Lard and its substitutes	21,980
Aug. 1892	Substitute for lard	21,769
Aug. 1892	Substitute for lard	55,186
Oct. 1892	Lard and its substitutes	22,211
.... 1892	Lard substitute and lard compound	42,548
Jan. 1893	Substitute for lard	22,537
Feb. 1893	Substitute for lard	22,797
Mar. 1893	Lard and its substitutes	22,911
Mar. 1893	Substitute for lard and butter	23,291
May 1893	Canned meats, lard, and substitutes for lard	25,514
May 1893	Compound used as a substitute for butter and lard	23,432
May 1893	Substitute for lard	23,527
Dec. 1893	Lard substitute	24,253
Mar. 1894	Lard compounds	25,773
Apr. 1894	Compound of cottonseed oil and oleostearin	105,926
May 1894	Fats and mixtures thereof used as foods or as ingredients in food	40,705
Aug. 1894	Lard and compound lard	25,324
Dec. 1894	Shortenings	26,141
Dec. 1894	Shortening compound of refined beef fat and cottonseed oil	100,146[a]
Jan. 1895	Lard compounds	26,087

TRADE-MARKS OF COMPOUNDED

For whom registered	Year	Title (and/or picture)
Schwarzschild & Sulzberger Co., Kansas City, Kan., Chicago, and New York	1907	S&S
Braun & Fitts, Chicago	1895	Fruit of the Meadow
Georgia Mills and Elevator Co., Macon, Ga.	1895	Plantene
McCaw Manufacturing Co., Macon, Ga.	1905	Plantene
Armstrong Packing Co., Dallas, Tex.	1912	Oak Leaf
Procter & Gamble Co., Cincinnati	1921	Flakewhite
Swift & Co., Chicago	1896	Cremol
N. K. Fairbank Co., Union Township, N.J., and Chicago, Ill.	1916	Los Tres Amigos (Three birds)
Procter & Gamble Co., Cincinnati	1922	Invincible
India Refining Co.,[a] Philadelphia	1908	Ko-Nut
Southern Cotton Oil Co., Jersey City and Bayonne, N.J.; New York, N.Y.; Gretna, La.; Savannah, Ga.; and Chicago, Ill.	1921	Wesson
Christr. Thomas & Bros., Ltd., Bristol, England	1900	Coconea
Christr. Thomas & Bros., Ltd., Bristol, England	1900	Christholine
Galban & Co., Inc., New York and Havana	1912	Competencia
Wesson Co., Jersey City, N.J., and Savannah, Ga.	1903	Palmatina
Wesson Co., Jersey City and Savannah	1903	Palmatina (Palm tree)
Wesson Co., Jersey City	1908	Palmatina
Wesson Co., Jersey City	1908	Palmatina (Palm tree)
W. R. Grace & Co., New York	1915	El Ciervo
Cudahy Packing Co., Chicago, Ill., and S. Omaha, Neb.	1901	Reina
Southern Cotton Oil Co., Jersey City, N.J., Savannah, Ga., Gretna, La.	1902	Snowdrift
Southern Cotton Oil Co., Jersey City and Bayonne, N.J.; New York, N.Y.; Gretna, La.; Savannah, Ga.; and Chicago, Ill.	1919	Snowdrift
Southern Cotton Oil Co., Jersey City and Bayonne, N.J.; New York, N.Y.; Gretna, La.; Savannah, Ga.; and Chicago, Ill.	1920	Snowdrift
Getz Bros. & Co., Inc., San Francisco	1912	Triumph
Swift & Co., Chicago	1906	La Vencedora
Armstrong Packing Co., Dallas, Tex.	1910	Bob White
Cudahy Packing Co., Chicago, Ill., and S. Omaha, Neb.	1901	Princesa

[a] Renewed by Palmolive Peet Co.

COOKING FATS (*Cont.*)

Use begun	Character of article	Numb
Feb. 1895	Certain named meats, lard, lard substitutes, and unctuous food substances	61,0
Apr. 1895	Prepared fatty oleaginous food substances	27,3
Sept. 1895	Substitute for lard	27,1
Sept. 1895	Substitute for lard	47,5
Jan. 1896	Compound of pure lard, edible fat, and cottonseed oil	87,4
Apr. 1896	Cooking fats	147,6
July 1896	Oleaginous food substances	28,7
.... 1897	Lard substitute consisting of cottonseed oil and beef fat	112,0
Apr. 1898	Cooking fats	156,7
June 1899	Certain vegetable fat or oil	69,4
June 1899	Prepared fatty, oleaginous, or unctuous food substance	145,0
Nov. 1899	Edible fats	34,1
Nov. 1899	Edible fats	34,1
.... 1899	Imitation lard	84,8
Jan. 1900	Prepared fatty, oleaginous, or unctuous food substances	40,0
Jan. 1900	Prepared fatty, oleaginous, or unctuous food substances	40,2
Jan. 1900	Mixture containing vegetable oil and animal fat	69,7
Jan. 1900	Mixture containing vegetable oil and animal fat	69,7
June 1900	Lard substitute composed of cottonseed oil and beef fat	104,5
Oct. 1900	Lard, lard compounds, and lard substitutes	36,5
Nov. 1900	Lard compound	38,0
Nov. 1900	Cottonseed oil shortening compound composed of fatty, oleaginous, or unctuous food substances	127,1
Nov. 1900	Vegetable shortening compound composed of fatty, oleaginous, or unctuous food substances	136,6
Dec. 1900	Oleaginous cooking compound	87,2
.... 1900	Lard and lard compounds	56,9
Jan. 1901	Compound of oleostearin and cottonseed oil	76,2
Mar. 1901	Lard, lard compounds, and lard substitutes	36,5

TRADE-MARKS OF COMPOUNDED

For whom registered	Year	Title (and/or picture)
Streett & Corkran Co., Baltimore.......	1907	Diamond ....
Hauser Packing Co., Los Angeles.......	1916	Violet ....
Southern Cotton Oil Co., Jersey City, N.J., Savannah, Ga., Gretna, La.......	1902	Snowdrop ....
Armour & Co., Chicago, Ill.	1902	White Cloud (Head of Indian)..
Cudahy Packing Co., Chicago, Ill., and S. Omaha, Neb.	1904	Infante ....
Swift & Co., Chicago..................	1902	Jewel ....
Southern Cotton Oil Co., Jersey City, N.J., Savannah, Ga., Gretna, La.	1903	La Veronica ....
Schwarzschild & Sulzberger Co., Kansas City, Kan., Chicago, Ill., and New York, N.Y.	1903	Silver Star (Two stars)........
Cudahy Packing Co., Chicago, Ill., and S. Omaha, Neb.	1906	White Ribbon ....
Cudahy Packing Co., Chicago, Ill., and Omaha, Neb.	1902	White Ribbon ....
Sherman Oil & Cotton Co., Sherman, Tex.	1903	Jack Frost ....
W. S. Forbes & Co., Richmond, Va......	1916	Ladina ....
Sherman Oil & Cotton Co., Sherman, Tex.	1903	Dixie ....
Schwarzschild & Sulzberger Co., Kansas City, Kan., Chicago, and New York...	1903	Crispene ....
Schwarzschild & Sulzberger Co., Kansas City, Kan., Chicago, and New York...	1907	Crispene ....
Procter & Gamble Co., Cincinnati.......	1917	Crispene ....
Western Meat Co., San Francisco.......	1929	Arrow ....
Cudahy Bros. Co., Cudahy, Wis.	1905	Peacock (Peacock) ....
Cudahy Bros. Co., Cudahy, Wis.	1904	Peacock (Peacock) ....
Kingan & Co., Ltd., Belfast, Ireland, and Indianapolis, Ind.	1918	Sea Foam (Sea foam)..........
N. K. Fairbank Co., Chicago............	1908	(Snowcapped mountains) ......
Cudahy Bros. Co., Cudahy, Wis.	1905	Snowball ....
Cudahy Bros. Co., Cudahy, Wis.	1904	Snowball ....
Cudahy Bros. Co., Cudahy, Wis.	1904	White Champion ....
Cudahy Bros. Co., Cudahy, Wis.	1905	White Champion ....
Southern Cotton Oil Co., Jersey City, N.J., Savannah, Ga., and Gretna, La. ..	1908	Neutralina ....
Sherman Cotton Oil Provision Co., Sherman, Tex.	1908	Dixie ....
Sherman Cotton Oil Provision Co., Sherman, Tex.	1908	Jack Frost ....
Charles S. Hardy, San Diego, Calif.	1904	Cotoc ....
Geo. P. Braun Co., Chicago............	1917	Cream-Flake ....
Swift & Co., Chicago..................	1906	(Conventionalized cut jewel with radiating rays) ....

[a] The month is uncertain.

COOKING FATS (*Cont.*)

Use begun	Character of article	Numbe
.... 1901	Substitute for lard	65,07
Jan. 1902	Shortening compound	110,04
Jan. 1902	Lard compound	38,06
Feb. 1902	Lard and lard compounds	38,03
Mar. 1902	Lard and lard compounds	42,30
Apr. 1902	Certain named packing-house products	38,53
Apr. 1902	Lard compound	40,98
Aug. 1902	Lard substitute	40,49
Sept. 1902	Lard and lard compound	49,17
Sept. 1902	Lard and lard compounds	39,33
Dec. 1902	Cooking fats and lard	39,82
.... 1902	Compound lard	112,49
Jan. 1903	Cooking fats and lard	39,89
Mar. 1903	Oleaginous or unctuous food substances	40,31
Mar. 1903	Oleaginous food substances, viz., lard substitute or lard compound	59,93
Mar. 1903	Lard compound of cottonseed oil and hard fat	119,37
May 1903	Bacon, picnics, and compound shortening	256,01
July 1903	Lard, tallow, lard compounds, and substitutes for lard	47,63
July 1903	Lard, tallow, lard compounds, and substitutes for lard	41,89
Sept. 1903	Compound, a substitute for lard	120,26
Nov. 1903	Edible fats and oils	69,36
Dec. 1903	Lard, lard compounds, tallow, and substitutes for lard	47,77
Dec. 1903	Lard, tallow, lard compounds, and substitutes for lard	41,87
Dec. 1903	Lard, tallow, lard compounds, and substitutes for lard	41,87
Dec.[a] 1903	Lard, tallow, lard compounds, and substitutes for lard	47,21
.... 1903	Vegetable oil and animal fat	67,06
.... 1903	Lard substitutes	68,15
.... 1903	Lard substitutes	68,15
May 1904	Certain named substitute for lard	43,11
Dec. 1904	Lard substitute	117,51
Mar. 1905	Lard and lard compounds	51,05

TRADE-MARKS OF COMPOUNDE

For whom registered	Year	Title (and/or picture)
Ammon & Person, Jersey City, N.J.	1906	Ba-ko
High Grade Lard Co., Baltimore	1908	Shortine
E. D. Cook & Co., Binghamton, N.Y.	1907	Cream Dove (Dove)
India Refining Co., Philadelphia	1908	Inreco
India Refining Co., Philadelphia	1908	Parasub
Cream Dove Mfg. Co., Inc., Binghamton, N.Y.	1928	Cream Dove (Dove)
N. K. Fairbank Co., Chicago	1919	El Tigre (Tiger's head in circle)
T. M. Sinclair & Co., Ltd., Cedar Rapids, Ia.	1907	Cottofat
George & Co., Ltd., Baltimore	1914	Old Plantation
Miner, Read & Garrette, New Haven, Conn.	1907	Cotscok
Schwarzschild & Sulzberger Co., Kansas City, Kan., Chicago, and New York	1907	Advance
Southern Cotton Oil Co., Jersey City and Bayonne, N.J., New York, N.Y., Savannah, Ga., Gretna, La., and Chicago, Ill.	1923	Carnaval
Geo. P. Braun Co., Chicago	1917	Liona
Sherman Cotton Oil Provision Co., Sherman, Tex.	1908	Blue Jay
T. M. Sinclair & Co., Ltd., Cedar Rapids, Ia.	1907	Frosto
Charles H. Brunier, Baltimore	1914	Extra Family Beauty
Blayney-Murphy Co., Denver, Colo.	1925	Silver Seal
Nuckolls Packing Co., Pueblo, Colo.	1928	Little Chief
Halstead & Co., Jersey City, N.J.	1910	Vesuvio
John H. Filbert, Baltimore	1908	Filburta
Interstate Cotton Oil Refining Co., Sherman, Tex.	1918	Dixie
T. M. Sinclair & Co., Ltd., Cedar Rapids, Ia.	1909	Tryit
Texas Refining Co., Greenville, Tex.	1914	(Certain words in circular drawing of man knocking out a pig)
Southern Cotton Oil Co., Jersey City, N.J., New York, N.Y., Savannah, Ga., and Gretna, La.	1908	Snowdrift
H. T. Cottam & Co., Ltd., New Orleans	1910	El Toro
Western Meat Co., South San Francisco, Calif.	1925	Califene
Columbia Cotton Oil and Provision Corp., Relee, Va.	1911	Pi Crus (Chef and pie)
Magnolia Cotton Oil Co., Houston, Tex.	1911	Crusto

[a] The date is uncertain.

COOKING FATS (*Cont.*)

Use begun	Character of article	Numbe
May 1905[a]	Shortening for pastry	51,01
Dec. 1905	Compound used as substitute for lard	67,15
Jan. 1906	Cooking compound made from vegetable oils and beef fats	63,39
Jan. 1906	Vegetable fat or oil compound	69,45
Jan. 1906	Certain vegetable fat or oil compound	69,45
Jan. 1906	Cooking compounds composed of cottonseed oil, oleostearin, and beef fats	250,10
Mar. 1906	Cooking compound containing cottonseed oil and oleostearin	85,90
Oct. 1906	Lard compound	60,71
Oct. 1906	Lard substitute	95,53
Nov. 1906	Substitute for lard (cottonseed oil and oleostearin)	62,04
Dec. 1906	Lard compound	64,92
Dec. 1906	Lard substitute and shortening composed of fatty, oleaginous, or unctuous food substances	169,22
Jan. 1907	Lard compound	117,41
May 1907	Lard substitutes	68,15
July 1907	Lard compound	66,31
Oct. 1907	Compound of cottonseed oil, oleostearin, and pure lard	95,88
Nov. 1907	Shortening	200,86
.... 1907	Compound lard substitute composed of refined vegetable oil and tallow	238,17
.... 1907[a]	Compound composed of beef fat and cottonseed oil	76,58
Jan. 1908	Compound of refined beef fat and cottonseed oil	70,78
Mar. 1908	Cottonseed-oil shortening	121,44
Sept. 1908	Compound of lard, beef fat, and cottonseed oil	73,11
Oct. 1908	Cooking oil containing cottonseed oil and beef stearin	96,46
Nov. 1908	Vegetable oil and animal fat	67,06
Jan. 1909	Certain foods (a compound of cottonseed oil and stearin)	78,23
June 1909	Cottonseed and oleostearin shortening	195,46
Oct. 1909	Oleaginous compound for pastry shortening	82,76
Oct. 1909	Cottonseed oil and an oleaginous compound for cooking purposes	82,80

TRADE-MARKS OF COMPOUNDED

For whom registered	Year	Title (and/or picture)
Columbia Cotton Oil and Provision Corp., Relee, Va.	1910	Blue Bell
N. K. Fairbank Co., Chicago	1914	Snowlene
Armour & Co., Chicago	1911	La Caravela (Sailboat)
Southern Cotton Oil Co., Jersey City and Bayonne, N.J., New York, N.Y., Gretna, La., Savannah, Ga., Chicago, Ill.	1920	Kneedit
Columbia Cotton Oil and Provision Corp., Relee, Va.	1911	Velvet
Natchez Packing Co., Natchez, Miss.	1911	White Mountain
Procter & Gamble Co., Cincinnati	1917	Crisco
Southern Cotton Oil Co., Jersey City and Bayonne, N.J., New York, N.Y., Gretna, La., Savannah, Ga., Chicago, Ill.	1920	Scoco
Jaburg Brothers, New York	1916	J.B. Special
Hammond Standish & Co., Detroit	1913	Oleard
J. B. Camors & Co., New Orleans	1913	El Gallito
Sears, Roebuck & Co., Chicago	1913	White Cliff
Interstate Cotton Oil Refining Co., Sherman, Tex.	1914	(Head of a middle-aged woman)
Capitol Refining Co., Inc., S. Washington, Va.	1915	White Dome
Berlin Mills Co., Berlin	1915	Kream Krisp (Kettle over fire)
Interstate Cotton Oil Refining Co., Sherman, Tex.	1917	(Middle-aged woman)
Interstate Cotton Oil Refining Co., Sherman, Tex.	1920	Mrs. Tucker's (Woman)
Interstate Cotton Oil Refining Co., Sherman, Tex.	1914	Log Cabin (Log cabin)
Interstate Cotton Oil Refining Co., Sherman, Tex.	1917	Log Cabin (Log cabin)
Interstate Cotton Oil Refining Co., Sherman, Tex.	1914	Jack Rabbit (Jack rabbit)
Interstate Cotton Oil Refining Co., Sherman, Tex.	1917	Jack Rabbit (Jack rabbit)
Corkran Hill & Co., Roland Park and Baltimore, Md.	1915	Terrapin (Terrapin)
Cudahy Packing Co., Chicago	1923	Flako
Atlanta Refining and Manufacturing Co., Atlanta, Ga.	1915	Cotton Bloom (Cotton bloom)
Southern Lard and Provision Co., Norfolk, Va.	1915	Old Glory
Sauté Products Corporation, New York	1915	Sawtay

COOKING FATS (*Cont.*)

Use begun	Character of article	Numb
Jan. 1910	Compound of cottonseed oil, beef fat, and oleostearin......	80,3
Jan. 1910	Cooking compound containing cottonseed oil and oleostearin	101,2
June 1910	Compound of cottonseed oil and oleostearin used as a substitute for lard..................................	83,1
Oct. 1910	Cottonseed oil shortening composed of fatty, oleaginous, or unctuous food substances..............................	129,2
Nov. 1910	Oleaginous compound for cooking purposes.............	82,1
Jan. 1911	Lard compound consisting of refined cottonseed oil and oleostearin	82,1
June 1911	Cooking fat	117,7
Nov. 1911	Shortening composed of fatty, oleaginous, or unctuous food substances	136,6
Dec. 1912	Bakers' shortening	109,3
Feb. 1913	Lard substitute (cottonseed oil, vegetable coloring, and beef fat)	92,9
Feb. 1913	Cooking compound composed of cottonseed oil, cottonseed oil stearin, and oleostearin..........................	93,2
Feb. 1913	Substitute for lard..................................	94,4
Aug. 1913	Lard substitute composed of cottonseed oil and oleostearin	96,4
Aug. 1913	Combination of animal fats used for shortening..........	102,5
Aug. 1913	Vegetable fats	105,4
Aug. 1913	Lard substitute composed of cottonseed oil and oleostearin	117,1
Aug. 1913	Shortening for cooking and oil for cooking or salad purposes	133,9
Oct. 1913	Shortening	98,5
Oct. 1913	Shortening compound	118,7
Feb. 1914	Lard substitute composed of cottonseed oil and oleostearin	98,2
Feb. 1914	Lard substitute composed of cottonseed oil and oleostearin	117,1
Mar. 1914	Cooking grease composed of cottonseed oil and oleostearin	103,6
June 1914	Shortening compound	168,3
Sept. 1914	Oleaginous compound for use as pastry shortening.......	103,8
Nov. 1914	Lard substitute	104,9
Dec. 1914	Pure butter of coconut for frying, baking, and shortening..	104,5

TRADE-MARKS OF COMPOUNDED

For whom registered	Year	Title (and/or picture)
D. D. Metcalf, Greenville, Ala.	1919	Met (Over calf's head)
D. D. Metcalf, Greenville, Ala.	1920	White Way
Kosher Products Co., Chattanooga, Tenn.	1916	Parafat
N. K. Fairbank Co., Union Township, N.J., and Chicago, Ill.	1916	Hydora
Florida Cotton Oil Co., Jacksonville, Fla.	1916	Flaco
Armstrong Packing Co., Dallas, Tex.	1916	El Pitirre (Picture)
Armstrong Packing Co., Dallas, Tex.	1916	El Pajarito (Picture)
De Jarnette Refining Co., Montgomery, Ala.	1916	King Cotton (Crown)
Capitol Refining Co., South Washington, Va.	1920	Combatiente (Gladiator)
Atlanta Refining and Manufacturing Co., Atlanta, Ga.	1917	Imperial (Crown)
Interstate Cotton Oil Refining Co., Sherman, Tex.	1916	White Beauty (Cotton boll)
Interstate Cotton Oil Refining Co., Sherman, Tex.	1917	White Beauty (Cotton boll)
Dixie Refining Co., Memphis, Tenn.	1916	Ole Mammy (Negress)
Procter & Gamble Co., Cincinnati	1917	Selex
Hodgson Oil Refining Co., Athens, Ga.	1919	Crystal Flake
Interstate Cotton Oil Refining Co., Sherman, Tex.	1917	Velvet
Ward Baking Co., New York	1919	Florolene
Armstrong Packing Co., Dallas, Tex.	1917	Nutrol
Haug & Co., New York	1922	High Point
Interstate Cotton Oil Refining Co., Sherman, Tex.	1925	Southern Queen
Interstate Cotton Oil Refining Co., Sherman, Tex.	1919	Phoebe Snow
Wyatt Bros., Chicago	1920	High Point
W. S. Forbes & Co., Richmond, Va.	1917	Polly-anna
W. S. Forbes & Co., Inc., Richmond, Va.	1919	Gladdens the Cook (Parrot)
Superior Products Co., St. Louis, Mo.	1918	Bakrite
Magnolia Provision Co., Houston, Tex.	1919	Crustene
Armstrong Packing Co., Dallas, Tex.	1918	Nutrola
Magnolia Provision Co., Houston, Tex.	1918	Pindapan
Magnolia Provision Co., Houston, Tex.	1918	Pindapan, the fat of the land (Peanut)

COOKING FATS (*Cont.*)

Use begun	Character of article	Numbe
.... 1914	Shortening compound	128,24
.... 1914	Shortening compound consisting of a mixture of fats and oils of approximately lard-like consistency	129,02
Jan. 1915	Cooking fats	108,47
Jan. 1915	Cooking compound made from cottonseed oil	110,49
Apr. 1915	Lard compound	108,63
June 1915	Pure lard and compound lard	109,05
June 1915	Pure lard and compound lard	109,05
Dec. 1915	Shortening composed of cottonseed oil and cottonseed-oil stearin	111,19
Mar. 1916	Shortening or artificial lard in two forms: (1) Cottonseed oil and stearin, and (2) Vegetable oil	137,57
May 1916	Oleaginous compound for use as pastry shortening	115,92
June 1916	Shortening	113,74
June 1916	Shortening	117,15
Aug. 1916	Shortening composed of cottonseed oil and cottonseed stearin	114,14
Sept. 1916	Cooking fat	114,82
Sept. 1916	Shortening composed of cottonseed oil and cottonseed-oil stearin	126,01
Oct. 1916	Shortening composed of cottonseed oil and oleostearin	117,86
Nov. 1916	Shortening composition consisting of flour, cornmeal, cornstarch, or like pulverulent carrier impregnated with hard fat	124,90
Jan. 1917	Lard substitute composed of cottonseed oil and oleostearin	118,48
Jan. 1917	Hydrogenated vegetable oil	154,56
Mar. 1917	Shortening made from cottonseed oil	205,18
Apr. 1917	Shortening composed of cottonseed oil and beef stearin	128,24
May 1917	Cottonseed stearin	129,10
June 1917	Shortening composed of cottonseed oil and cottonseed stearin	119,95
June 1917	Vegetable shortening	125,63
Oct. 1917	Baking compound .... having as its base peanut oil and coconut oil	121,73
Nov. 1917	Oleaginous compound, a substitute for lard	126,17
Dec. 1917	Compound of peanut oil and oleostearin	123,96
Feb. 1918	An oleaginous compound produced from peanuts for cooking purposes	122,80
Feb. 1918	An oleaginous compound produced from peanuts for cooking purposes	123,61

TRADE-MARKS OF COMPOUNDE

For whom registered	Year	Title (and/or picture)
Magnolia Provision Co., Houston, Tex...	1918	The Fat of the Land.........
N. K. Fairbank Co., Union Township, N.J., and Chicago, Ill.	1919	Fairco ....
Morris & Co., Chicago..................	1918	Domino (Border of dominoes).
Wyatt Bros., Chicago..................	1922	High Melt ....
Dixie Refining Co., Memphis, Tenn.	1920	White Cross ....
King R. Graham, Inc., New York.......	1919	Kubo ....
Dixie Refining Co., Memphis, Tenn.	1919	Kotawhite ....
F. E. Patrick–Young Co., Richmond, Va.	1922	Snowcream ....
John Morrell & Co., Ottumwa, Ia.	1919	Allrite (Two signals down, a within a heart)............
Swift & Co., Chicago	1930	Vream ....
Edible Oil Co., Inc., Louisville, Ky.	1919	Needo ....
Procter & Gamble Co., Cincinnati.......	1920	Nutex ....
Chapman & Smith Co., Chicago........	1921	Bakeree ....
Hannah E. Kriel, Baltimore...........	1919	Cosedo ....
Wisconsin Butterine Co., Milwaukee...	1919	Nudoe ....
International Vegetable Oil Co., Atlanta	1920	Ivoco ....
W. S. Forbes & Co., Inc., Richmond, Va.	1922	Swan (Swan) ....
Aspegren & Co., New York.............	1920	Fluffo ....
Abraham Cohen, Baltimore............	1921	Star Light ....
Southern Cotton Oil Co., Jersey City and Bayonne, N.J., New York, N.Y., Gretna, La., Savannah, Ga., Chicago, Ill.	1921	Cocobianca ....
Hodgson Oil Refining Co., Athens, Ga. ..	1920	Gem White ....
Philippine Mfg. Co., Manila, P.I.	1925	Purico (In oval with sunset anc sea background) ....
Wm. Schluderberg–T. J. Kurdle Co., Baltimore	1928	Southern Rose ....
Lever Bros. Co., Cambridge, Mass.	1920	Cooket ....
Boyd Packing Co., Richmond, Va.	1925	Cremo ....
Lever Bros. Co., Cambridge, Mass.	1921	Holsum (Spoon and shortening)
Kaufman Packing Co., Inc., Baltimore..	1921	Blue Seal ....
Dry Oil Products, Ltd., London, England, New York and Trout Creek, N.Y.	1921	Dacko ....

COOKING FATS (*Cont.*)

Use begun	Character of article	Number
Feb. 1918	An oleaginous compound produced from peanuts for cooking purposes	123,618
Feb. 1918	Shortening compound containing cottonseed oil and oleostearin	126,274
Apr. 1918	Vegetable shortening	123,260
May 1918	Cottonseed-oil stearin	156,973
June 1918	Lard compound of cottonseed oil and cotton-oil stearin	130,174
June 1918	Margarin cooking compound	125,644
July 1918	Vegetable shortening composed of cottonseed oil and hardened cottonseed oil	124,233
July 1918	Lard substitute composed of cottonseed oil and oleo beef stearin	154,803
Oct. 1918	Vegetable shortening	127,641
Oct. 1918	Shortening made of vegetable oil	278,830
Nov. 1918	Vegetable shortening	126,271
Dec. 1918	Cooking fat, namely lard substitute made from cottonseed oil	128,488
Feb. 1919	Shortening compound	147,081
Mar. 1919	Lard substitute composed of cottonseed oil and other ingredients	126,942
Mar. 1919	Lard substitute . . . . peanut oil, coconut oil, and beef stearin	127,557
Mar. 1919	Certain named foods (among others, lard compound of cottonseed oil, oleostearin, and cottonseed-oil stearin)	136,479
Mar. 1919	Lard substitute or compound composed of cottonseed oil and oleostearin	154,547
July 1919	Shortening and frying medium	131,026
Aug. 1919	Cooking and shortening compound	146,201
Oct. 1919	Edible oil compound of fatty, oleaginous, or unctuous food substances	138,708
Oct. 1919	Lard substitute	133,261
.... 1919	Vegetable lard compound	204,840
Jan. 1920	Packers' products (lards and lard compounds made from cottonseed oil and other oils)	238,495
Mar. 1920	Cooking compound of oils and hydrogenated oils	134,252
Mar. 1920	Lard compound composed of vegetable oil, oleostearin, pure lard, and cheese	194,794
Apr. 1920	Cooking compound comprising oils and hydrogenated oils	141,161
May 1920	Lard substitute containing cottonseed oil	138,651
Sept. 1920	Dry pulverulent mixtures containing fats and oils for a shortening in cooking	146,082

TRADE-MARKS OF COMPOUNDE

For whom registered	Year	Title (and/or picture)
Oliver Wynne, Norfolk, Va.	1921	Wynne's Winner
Oliver Wynne, Norfolk, Va.	1921	Pride of Norfolk
South Texas Cotton Oil Co., Houston, Tex.	1925	Pancrust
Eney Shortening Co., Chicago	1921	En-Co
Eney Shortening Co., Chicago	1921	Baker Maid (Baker made)
Oliver Wynne, Norfolk, Va.	1921	Faultless
Globe Cotton Oil Mills, Los Angeles	1921	"A1" Brisq
Nucoa Butter Co., New York	1921	Nuflake, Pure Vegetable Compound (In circle with head)
Nucoa Butter Co., New York	1925	Golden Flake—Pure Vegetable Shortening (Chef's head)
Oliver Wynne, Norfolk, Va.	1922	Wynne's Wynner
Oliver Wynne, Norfolk, Va.	1922	Armco Special
Hedwig R. Eliah, Philadelphia	1921	Miskca
Procter & Gamble Co., Cincinnati	1921	Fritina
Wynne Lard & Provision Co., Inc., Norfolk, Va.	1923	Albemarle Brand
Wynne Lard & Provision Co., Inc., Norfolk, Va.	1923	A No. 1 Brand
Wynne Lard & Provision Co., Inc., Norfolk, Va.	1924	Great Southern
Wynne Lard & Provision Co., Inc., Norfolk, Va.	1924	Old Mill (Windmill)
Wynne Lard & Provision Co., Inc., Norfolk, Va.	1924	Ermco Brand
Wynne Lard & Provision Co., Inc., Norfolk, Va.	1924	Silver Bell
Procter & Gamble Co., Cincinnati	1922	Savora
Jefferson Co., Inc., Richmond, Va.	1923	Snow Queen
N. K. Fairbank Co., Union Township, N.J., and Chicago, Ill.	1923	Cream of Vegetable Oil
Central Food Products Co., Chicago	1924	Light House
Southern Cotton Oil Co., Jersey City, N.J., New York, N.Y., New Orleans, La., Savannah, Ga., Chicago, Ill.	1923	MFB, a special vegetable fat (In circle)
David A. Blanton, St. Louis, Mo.	1922	Excello
Swift & Co., Chicago, Ill.	1923	La Princesa (Woman)
Wynne Lard & Provision Co., Inc., Norfolk, Va.	1923	Pure Gold Brand

COOKING FATS (*Cont.*)

Use begun	Character of article	Number
Sept. 1920	Lard substitute composed of cottonseed oil and other ingredients	145,211
Sept. 1920	Lard substitute composed of cottonseed oil and other ingredients	145,213
Sept. 1920	Vegetable shortening	206,198
Oct. 1920	Shortening	142,515
Oct. 1920	Shortening	142,995
Nov. 1920	Lard substitute composed of cottonseed oil and other ingredients	148,773
Nov. 1920	Vegetable compounds for shortening and cooking purposes	144,776
Dec. 1920	Vegetable shortening	146,827
Dec. 1920	Vegetable shortening	200,886
Dec. 1920	Lard substitute composed of cottonseed oil and other ingredients	154,746
Jan. 1921	Lard substitute composed of cottonseed oil and other ingredients	152,011
Jan. 1921	Lard substitutes	149,373
Feb. 1921	Cooking fats	147,810
Mar. 1921	Lard substitute	176,804
Mar. 1921	Lard substitute made from cottonseed oil and oleo stearin	176,940
Mar. 1921	Lard substitute	180,296
Mar. 1921	Lard substitute	180,297
Mar. 1921	Lard substitute	180,298
Mar. 1921	Lard substitute	180,299
Mar. 1921	Cooking fats	150,524
June 1921	Vegetable shortening, lard substitute	170,221
June 1921	Vegetable shortening compound	172,051
July 1921	Shortening compound composed of beef fat and corn oil	190,686
Aug. 1921	Shortening or fat composed of fatty, oleaginous, or unctuous food substances	167,017
Sept. 1921	Shortening	156,568
Nov. 1921	Lard substitutes	167,712
Nov. 1921	Lard substitute	176,807

TRADE-MARKS OF COMPOUNDE

For whom registered	Year	Title (and/or picture)
Higgins Manufacturing Co., Providence, R.I.	1924	Higgins Nut Product
Higgins Manufacturing Co., Providence, R.I.	1924	(Two-lined triangle)
Van Camp Packing Co., Indianapolis, Ind.	1926	Van-Co
Aspegren & Co., Inc., New York	1925	Crackerjack
Brown Orcola Co., Chicago	1923	Ocro
John Morrell & Co., Ottumwa, Iowa	1926	Airship (Airship)
Associated Meat Co., Los Angeles	1929	Laverne
Cooknut Corporation, Baltimore	1923	Kukol
Cooknut Corporation, Baltimore	1923	Bakwell
Société de Stéarinerie et Savonnerie de Lyon, Lyon, France	1924	Chocolite
American Cotton Oil Co., New York	1924	Sierra (Mountain peaks)
Alberto Valez Co., New Orleans	1924	Selvaco
Aspegren & Co., Inc., New York	1925	Superla
Hauser Packing Co., Los Angeles, Calif.	1925	Kreamola
Anaheim Beef Co., Anaheim, Calif.	1925	Krispy Krust
I. Rokeach & Sons, Inc., Brooklyn, N.Y.	1925	Nyafat
I. Rokeach & Sons, Inc., Brooklyn, N.Y.	1925	(Hebrew characters meaning neither milk nor meat)
I. Rokeach & Sons, Inc., Brooklyn, N.Y.	1928	(Hebrew characters meaning Rokeach's Nyafat Kosher)
Baltimore Butterine Co., Baltimore, Md.	1925	Nu-Ine
Chiknut Corporation, Brooklyn, N.Y.	1925	Chiknut
Paul A. Sherikjian, Holyoke, Mass.	1926	Golden Eagle Rico (Eagle)
Aspegren & Co., Inc., New York	1925	Quix
Best Foods Inc., New York	1925	Best Foods Shortening
David A. Blanton for The Blanton Co., St. Louis, Mo.	1925	Blanton's Bond
Danish Packing Co., Ltd., Providence, R.I.	1927	Penobscot
Portsmouth Cotton Oil Refining Corp., Portsmouth, Va.	1926	Primex
K & F Vegetable Products Co., Philadelphia	1927	Shekedol
Armstrong Packing Co., Dallas, Tex.	1926	Cooklite
Virginia Lard and Provision Co., Inc., Norfolk and Portsmouth, Va.	1928	Sunnyland

[a] Use begun not less than one year before date of registration.

COOKING FATS (*Cont.*)

Use begun	Character of article	Number
Jan. 1922	Solid cooking or shortening compound of vegetable or nut oil	190,635
Jan. 1922	Solid cooking or shortening compound of vegetable or nut oil	191,756
Jan. 1922	Vegetable shortening	212,292
Feb. 1922	Lard substitutes in the nature of solid cooking fat for shortening and frying mediums	207,111
Apr. 1922	Shortening: a greasy, pasty substance used in mixing dough for baking and cooking	170,580
June 1922	Lard, shortening composed of vegetable oils and animal fats	212,191
July 1922	Vegetable shortening	264,153
Oct. 1922	Vegetable lard substitute	171,127
Oct. 1922	Vegetable lard substitute	173,774
Feb. 1923	Artificial lard and cooking oil prepared by hydrogenation	186,085
Mar. 1923	Hard fats and cottonseed oils	179,043
Aug. 1923	Vegetable shortening	179,056
Oct. 1923	Lard substitutes for shortening and frying mediums	199,817
Jan. 1924	Lard substitutes, viz., vegetable shortening compounds	204,030
Mar. 1924	Shortening made of vegetable and animal oils and fats	198,954
May 1924	Vegetable fat	203,870
.... 1924[a]	Vegetable fat including solidified vegetable fat	206,851
May 1924	Vegetable fat	246,328
Jan. 1925	Compound for shortening, baking, and cooking composed in part of coconut oil and a small amount of peanut oil	199,535
Jan. 1925	Pure vegetable fat for cooking	203,244
Feb. 1925	Solid cooking fat and shortening composed of animal fats	211,903
Mar. 1925	Vegetable shortening	202,692
May 1925	Shortening	207,025
June 1925	Prepared shortening, oleomargarine, and salad oil	206,360
Aug. 1925	Solid cooking or shortening compound of vegetable oil	223,496
May 1926	Vegetable shortening	218,925
July 1926	Pure vegetable fat for baking, frying, cooking, and shortening	224,894
Aug. 1925	Cottonseed oil shortening	216,783
Sept. 1926	Lard substitute composed of vegetable fats, oleostearin, beef fat, pure lard	244,599

TRADE-MARKS OF COMPOUNDE

For whom registered	Year	Title (and/or picture)
E. F. Drew & Co., Inc., New York	1929	Xtra Fine
Musher and Co., Washington, D.C.	1928	Shortnaise
Vegetable Products, Inc., Newark, N.J.	1928	O-Veg
Vejola Co., Inc., Philadelphia, Pa.	1928	Vejola
Arizona Packing Co., Phoenix	1929	Fenix
Wilson & Co., Inc., Chicago	1928	Hydro-fat
Ida Kossoff, New York	1928	Kossofat
Swift & Co., Chicago	1928	Fryene
Baltimore Butterine Co., Baltimore	1928	Nut-ie
Texas Vegetable Oil Co., San Antonio, Tex.	1928	Suncrisp
Musher and Co., Washington, D.C.	1928	Saba, Jose Sabate
Swift & Co., Chicago	1929	Sanco
Edwardsville Creamery Co. (Ill-Mo Nut Margarine Co.), Edwardsville, Ill.	1929	Ill-Mo Shortening
J. E. Duffner (Southern Products Co.), Oklahoma City, Okla.	1929	Preferd-Nut
Van Camp Packing Co., Indianapolis, Ind.	1930	Creamtex
Gulf & Valley Cotton Oil Co., Inc., New Orleans	1930	Blue Plate Shortening (Three plates)
Lyto Corporation, New York	1929	Lyto
Vegetable Oil Products Co., Inc., Los Angeles	1930	White Cap (Chef's head)
Corn Products Refining Co., New York	1930	Mazola Shortening
Globe Grain & Milling Co., Los Angeles, Calif.	1930	Bestola
Glidden Co., Cleveland, Ohio	1930	Durko

COOKING FATS (*Concluded*)

Use begun	Character of article	Numbe
Nov. 1926	Vegetable compound for baking, shortening, and cooking	255,30
Sept. 1927	Vegetable shortening and vegetable shortening with milk used as a baking compound	238,19
Oct. 1927	Vegetable shortening	238,71
Nov. 1927	Compound of vegetable fat, ... principally coconut oil, for frying, baking, and shortening	243,98
Nov. 1927	Pure-food vegetable shortening composed of cottonseed oil and other ingredients	255,86
Nov. 1927	Hydrostearoleine composed of hydrogenated vegetable oil of lard-like appearance and consistency	245,63
Jan. 1928	Vegetable fat	246,82
Jan. 1928	Frying fat	249,69
Jan. 1928	Lard substitute	242,78
May 1928	Vegetable shortening	247,15
May 1928	Shortening consisting of blended or mixed hardened oils and fats	247,00
Sept. 1928	Vegetable shortening	257,76
Nov. 1928	Nut shortening	257,74
Dec. 1928	Nut product used as a shortening	256,31
Jan. 1929	Vegetable shortening	267,42
Feb. 1929	Shortening or cooking fat composed of fatty, oleaginous, or unctuous food substances	274,57
Mar. 1929	Vegetable fat in the nature of a lard substitute	260,27
May 1929	Vegetable shortening	270,15
Aug. 1929	Pure vegetable fat for shortening and frying	266,39
Mar. 1930	Oil shortening	277,87
June 1930	Pure vegetable shortening	278,83

APPENDIX E

EXCERPTS FROM UNITED STATES FOOD ADMINISTRATION REPORTS AND REGULATIONS

"*Fats.*—The importance of fats and oils in the diet of the people, together with the scarcity of these products in all the belligerent countries except the United States, caused the Food Administration to lay particular stress upon their conservation. No complete survey of the fat situation had ever been made and under Food Administration control it was necessary to make such a survey with special reference to vegetable oils. With the knowledge of the supply thus obtained, special attention was given to the control of the supply through a control over exports and imports. Through the action of the War Trade Board exports of fats to neutrals were greatly restricted and where allowed were generally limited to the minimum requirements of the importing country.

"The increased production of animal fats through the stimulation of hog production is hereinafter referred to. A few compulsory measures were adopted to prevent waste in the use of fats. Cottonseed crushers and refiners were required by regulation to extract the greatest possible amount of edible oil. The use of shortening in bread was limited by the bakery regulations so that no more than two pounds of vegetable shortening could be used to one barrel of flour. The use of lard in bread was entirely forbidden and the amount of fat used in other bakery products was also limited. These regulations merely insured that no more shortening could be used by bakers than was in fact necessary. As elsewhere noted, careful attention was also given to the conservation of fats through the increased utilization of garbage. The conservation of butter also held an important place in the conservation program.

"The special license regulations referring to vegetable oils will be found in Exhibit Q."[1]

. . . .

"*Cotton seed and its products.*—Prior to Food Administration control merchandizing methods were conspicuously absent in this industry and at each turnover of seed or oil or meal the speculative feature was more often than not present. It was

[1] *Annual Report of the United States Food Administration for the Year 1918* (Washington, D.C., 1919), 13.

characteristic of both small and large dealers as in no other industry, and in equal measure created the necessity for and the difficulty of control. The Food Administration rules were aimed at hoarding, speculation, and resales. The resulting decrease in speculation, combined with several agreements between the Food Administration and the trades, resulted in a price stabilization for the 1917 crop after the greater part of the crop had been marketed and the costs of the raw materials thereby determined. In addition for the 1917 crop the Food Administration prescribed maximum spreads for cottonseed dealers and crushers and for refiners of oil, and for lard substitute manufacturers. The success of this action is indicated by the fact that although the farmer received approximately $10 per ton more for his cotton seed than in the previous year the lard substitutes and cottonseed meal were delivered to the consumer at no greater cost than in 1917.

"For the 1918 crop, after conferences with producers, dealers, and refiners, the Food Administration announced a stabilized price for cotton seed of $70 per ton in car lots f.o.b. cars, based on a yield of 41 gallons per ton of seed, and a price varying above and below this basis according to the quality of the seed measured by its yield in products in the different zones established by the Food Administration. Analyses were made from time to time in the various sections to determine the quality of the seed. This stabilization has proven satisfactory and has met the approval of producers generally.

"Copy of the regulations governing dealers and brokers in cotton seed and its products and manufacturers of oleomargarine and other butter substitutes, etc., is attached as Exhibit Q."[1]

. . . .

"EXHIBIT Q.

"UNITED STATES FOOD ADMINISTRATION—SPECIAL LICENSE REGULATIONS NO. IX.

"Dealers and Brokers in Cotton Seed and Peanuts and Cotton Ginners—Crushers of Cotton Seed, Peanuts, Soya Beans, Palm Kernels, and Copra—Importers of Peanuts, Peanut Oil, Soya Beans, Soya-Bean Oil, Palm Kernels, Palm-Kernel Oil, Copra, Copra Oil, and Palm Oil, and Dealers and Brokers in Such Imported Products—Refiners of, and Dealers and Brokers in, Cotton-Seed Oil, Peanut Oil, Soya-Bean Oil, Palm-Kernel Oil, and Copra Oil.

"Effective July 1, 1918.

"This pamphlet contains all special regulations applying to the licensees named above, issued up to and including July 1, 1918. All licensees are also subject to General License Regulations No. 1, issued

[1] *Ibid.*, 20–21.

in a separate pamphlet. General and special regulations of this series supersede all regulations of series B as for the above licensees on July 1, 1918.

"[IX—A—1, 2, 3, 4.]

"SPECIAL LICENSE REGULATIONS No. IX. . . . .

"A. *Special Regulations Governing Licensees Dealing in Cotton Seed and Peanuts, Brokers, in Such Commodities, and Cotton Ginners. . . . .*

"RULE 2. *Cotton seed not to be sold for feed or fertilizers.*—The licensee shall not, without the written consent of the United States Food Administrator, sell or use cotton seed for feed or fertilizers. . . . .

"[IX—A—1, 2, 3, 4, 5, 6, 7. Dec. 13, 1918. Substitute this for IX—A—1, 2, 3, 4 and IX—A—5, 6, 7 (*a*).] . . . .

"RULE 5. *Cotton seed or peanuts to be sold at not more than reasonable advance over cost.*—The licensee shall sell cotton seed and peanuts at not more than a reasonable advance over the actual cost to him of the particular cotton seed or peanuts sold without regard to the market or replacement value at the time of sale.

"NOTE.—Effective July 1, 1918, and until further notice the United States Food Administration will regard any sale of cotton seed at advances greater than those indicated below over the prices paid for such cotton seed as a violation of the above rule:

"(1) Purchase and sale of cotton seed where the licensee provides the necessary facilities and capital, and bears the expenses and risks incident to the business, $3 per ton (including delivery and loading of seed into cars at mills.)

"(2) Purchase and sale of cotton seed where the licensee operates as principal but his capital is furnished by another and his expenses and business risks and facilities in whole or in part are borne by another, or where the licensee operates as agent under his own license or under the license of another, $1.50 for each ton of cotton seed negotiated by him. The remainder of the margin as provided for in paragraph 1 shall be retained by the party or parties furnishing the capital and facilities and assuming the risks and expenses in whole or in part.

"(3) Any margin or commission in excess of 25 cents per ton to a licensee operating either as broker or as dealer who buys and sells cotton seed in car lots will be regarded as unreasonable. Any commission must be paid by either the seller or final buyer out of his spread or margin, and if any dealer in car lots takes a margin for such handling the person who buys from him shall deduct such margin from his own permissible spread or margin unless it has already been deducted by the original seller. . . . ."[1]

"[IX—D—1, 2, 3, 4, 5, 6.]

"D. *Special Regulations Governing Refiners of Cottonseed Oil, Peanut Oil, Soya-Bean Oil, Palm-Kernel Oil, Palm Oil, and Copra Oil, and Dealers and Brokers in Such Refined Oil.*

"RULE 1. *Cottonseed oil or peanut oil not to be bought or sold before August 1.*—The licensee shall not buy or sell any cottonseed oil

[1] *Annual Report of the United States Food Administration . . . . 1918*, 155, 156–57.

or peanut oil made or to be made from new-crop cotton seed or peanuts grown in the United States before August 1 of the year when such crops are grown.

"RULE 2. *Refiners must use efficient methods.*—The licensee shall refine in an efficient method to produce the largest yield of [e]dible oil.

"RULE 3. *Contracts must provide for delivery in four months.*—The licensee shall not make any contract for the sale of refined cottonseed oil, refined peanut oil from domestic peanuts, or refined soya-bean oil from domestic soya beans for shipment or delivery more than four months after the making of such contract.

"RULE 4. *Imported oil to be sold only against actual purchases.*—The licensee shall not contract to sell refined oil made from imported commodities except against actual purchases of the imported material.

"RULE 5. *Domestic oil to be sold at reasonable advance over cost.*—The licensee shall sell cottonseed oil, peanut oil manufactured from domestic peanuts, and soya-bean oil manufactured from domestic soya beans, at not more than a reasonable advance over the average cost to licensee of the crude oil from which such oil was refined. The licensee may consider all refining plants operated by or controlled by such licensees as a single unit. Licensees who control mills crushing oleaginous materials must credit all raw materials obtained from such crushing mills at the same price at which they could purchase the same products in the open market at the time of transfer.

"NOTE.—The United States Food Administration will indicate from time to time what margins it considers fair.

"RULE 6. *Carload shipments—Minimum weights.*—All carload shipments of cotton seed oil when in tank cars shall be loaded to capacity unless different minimum is authorized by special written permission of the United States Food Administrator."[1]

. . . .

"Wholesalers and jobbers of nonperishable food commodities.—Wholesalers and jobbers and those retailers subject to license were required to apply for a license on or before November 1, 1917, by the proclamation, copy of which was included in our last annual report. One of the basic regulations governing these licenses required them to sell nonperishable food commodities at not more than a reasonable margin over their average invoice cost. The purpose of the rule was to protect the consumer from the inflated market values then existing, due to speculation and the extraordinary conditions prevailing. The Food Administration ruled that a reasonable margin did not exceed the margin customarily enjoyed before the war or an even market under free competitive conditions. The result was the sale of these stocks in most instances at a reasonable profit, but at prices far below the replacement value, and the saving to consumers of sums which in the aggregate were enormous.

[1] *Ibid.*, 163.

"Later, maximum margins were prescribed for the more important nonperishable commodities, such as sugar, flour, ham, bacon, lard, sirups, canned fish and vegetables, and dried fruits. A full list of these commodities and the maximum margins fixed therefor will be found in the special license regulations governing dealers in nonperishable food commodities, attached hereto as Exhibit R.

"The regulations further provided that goods should be kept moving in a direct line from the producer to the consumer. No resales within the same class of trade were allowed except for justifiable causes where some special economic service was performed, and in such cases the parties to the transaction were as a rule held to a joint profit which could not exceed that allowed to a single dealer."[1]

. . . .

"EXHIBIT R.

"UNITED STATES FOOD ADMINISTRATION SPECIAL LICENSE REGULATIONS NOS. XI AND XII.

"*Wholesalers, Jobbers, Importers, Retailers, and Brokers of Licensed Nonperishable Food Commodities (Including Official Interpretations).*

"Effective June 15, 1918.

"This pamphlet contains all special regulations applying to the above licensees issued up to June 15, 1918. Such licensees are also subject to General Regulations No. I, dated May 3, 1918, which, together with this pamphlet, supersede, as to the above licensees, all regulations of Series B on June 15, 1918. . . .

"XI. WHOLESALERS, JOBBERS, IMPORTERS, RETAILERS.

"*A. Special Rules Applying to Licensed Nonperishable Food Commodities* . . . .

. . . .

"Maximum Margins on Sales by Wholesalers to Retailers. . . .

"[XI—A—5, note, *continued* (1) (*a*). Nov. 1, 1918. Substitute this for pages XI—A—5—note, *continued* (1) and XI—A—5—note, *continued* (2).] . . . .

"*Margins and profits.*— . . . .

"Sale of lard substitutes:

"The following ruling has been made by the law department in reply to an inquiry regarding jobbers' margins on lard substitute:

"'We beg to acknowledge your letter of September 28 in which you inquire whether it is against the Food Administration regulations for a wholesale jobber to sell lard substitute at less than 24¼ cents, tierce basis, which under the stabilized program he purchases at 23

[1] *Op. cit.*, 24.

cents. The Food Administration regulations provide a maximum margin for the wholesaler of 1¼ to 2 cents per pound over the purchase price delivered at railroad station. A general stabilization program affecting lard substitute and other cottonseed products has now been adopted by the Food Administration for the purpose of eliminating speculation and reducing the margin between the producer of cottonseed and the consumer of lard substitute, and this program has been approved by representatives of all interests concerned who have expressed their desire to cooperate. In view of the circumstances surrounding this program, it will hereafter be considered an unfair practice for any jobber to sell lard substitutes or lard compound in lots of less than 5,000 pounds at a margin over his delivered purchase price less than 1¼ cents (or 1½ cents where the jobber purchases in lots of 30,000 pounds or more and receives a concession of one-fourth cent).

" 'It should be pointed out that this action rests solely on the peculiar circumstances surrounding the cottonseed program. The reasons applying to lard substitute do not apply to any other commodity handled by wholesale grocers; and the policy of the Food Administration and its Distribution Division is decidedly opposed to the application of any similar principle to other commodities.

" 'It should further be pointed out that the 2-cent maximum margin for jobbers applies on the actual purchase price. The jobber who purchases in lots of 30,000 pounds at 22¾ cents must sell at not to exceed 24¾ cents.'

"The maximum margins permitted on sales of nonperishables by wholesalers to retailers prescribed in the announcement of June 6, 1918, and in the note to Rule XI—A—5 include local cartage, but does not include delivery charges incurred by the wholesaler in delivering by truck to points to which shipment might be made by rail. The actual expenses of making such deliveries by truck may be charged by the seller to the parties to whom the sale is made after the price has been fixed by the seller in conformity with said Rule A—5 and announcement of June 6. In no case, however, shall the added charge be in excess of the freight charge. (Opinion A—113, July 26, 1918.)

"A brokerage may be paid to a broker in a permissible resale from one jobber or wholesaler to another. The brokerage must, however, be deducted from the profit of either the buyer or seller, so that the price of the goods in the course of further distribution shall not bear such brokerage. (Opinion A—118, Aug. 26, 1918.)"[1]

. . . .

"EXHIBIT S.

"UNITED STATES FOOD ADMINISTRATION, SPECIAL LICENSE REGULATIONS NO. XIII—MANUFACTURERS OF BAKERY PRODUCTS (INCLUDING OFFICIAL INTERPRETATIONS.)

"This pamphlet contains all special regulations applying to manufacturers of bakery products issued up to and including May 3, 1918,

[1] *Ibid.*, 167, 168, 175, 176, 177–8.

and supersedes Bakers' Regulations, Series D. Such licensees are also subject to General Regulations No. 1, issued as a separate pamphlet. . . . .

"SPECIAL LICENSE REGULATIONS NO. XIII.

"*A. Special Regulations Applying to All Licensees Manufacturing Bakery Products. . . . .*

"[XIII—A—5, 6, 7.]

"RULE A—5. *Stocks of wheat flour, sugar, and shortening, limited.*—The licensee shall not, without the written consent of the United States Food Administrator, or his duly authorized representative, keep on hand or have in possession or under control, by contract or other arrangement, at any time, wheat flour or sugar in a quantity in excess of the reasonable requirements of his business for use by him during a period of 30 days, or shortening in a quantity in excess of the reasonable requirements of his business for use by him during a period of 60 days: *Provided, however,* That this rule shall not prevent the licensee having in transit sufficient flour or sugar or shortening to maintain the licensee's stock within the limits herein fixed.

"NOTE.—Only in cases in which peculiar circumstances demand it, will permission be given to a licensee to keep more than 30 days' supply of flour or sugar or more than 60 days' supply of shortening on hand or under control. A licensee who desires to make an application for such permission should present his case to the Federal Food Administrator for the state in which the bakery for which permission is asked is located.

"This rule does not prohibit a licensee who is entitled to use butter from holding or arranging for a season's supply. . . . ."[1]

. . . .

Special Regulations for Licensees Engaged in the Business of Manufacture and Dealing in Lard Substitutes

Special Permits May Be Issued in Special Cases

RULE 1.—Every licensee engaged in the manufacture of lard substitutes shall be subject to the following rules, provided, that in any special instance the United States Food Administrator may issue a special permit authorizing an exception to be made:

Hoarding—Season's Supply.

a) He shall not store, keep on hand, or have in his possession or under control by contract, or other arrangement, at any time: . . . . (2) Any lard substitute, other than of his own manufacture.

b) He shall not carry in stock any lard substitute for a period exceeding thirty days.

[1] *Annual Report of the United States Food Administration . . . . 1918,* 223, 225.

Contracts for Delivery Beyond Thirty Days, Prohibited. . . . .

Contracts in Excess Manufacturing Capacity, Prohibited. . . . .

Sales to Certain Concerns, Prohibited. . . . .

e) He shall not knowingly make any sales of lard substitutes to any firm, corporation, association or individual who is not regularly engaged in the necessary distribution or in the use or consumption of lard substitutes.

Purchase of Raw Material. . . . .

f) He shall not knowingly make any purchases of the raw materials entering into the manufacture of lard substitutes from any firm, corporation, association or individual who is not regularly engaged in the necessary distribution or in the production of said commodities.

Manufacturer's Price; Differential. . . . .

RULE 6.—No manufacturer engaged in the manufacture of lard substitutes shall, without the written permission of the United States Food Administrator, sell or offer to sell lard substitutes at higher prices in one market than he is selling or offering to sell the same quality or brand in any other market on the same day.

Differentials. . . . .

NOTE.—The selling price of lard substitute, delivered, tierce basis, is 22½ ¢ per pound in lots of 5,000 pounds or more and 23¾ ¢ per pound in lots of less than 5,000 pounds, based upon the customary terms of payment within 30 days, with privilege to the buyer of ½ of 1% discount for payment within 10 days. An additional discount of ¼ of 1% shall be made to buyers of 30,000 pounds gross or over. These prices, when for export, apply delivered at American seaport. The following differentials shall apply to package or case goods, over and above the base price as specified above.

d) These findings are based upon the price received by the producer for his cotton seed translated into the fair price of cotton seed oil, which oil you have been requested to purchase, treat and store in order that it may, without advance in price, be available to the consumer as cooking fat in the approaching period of scarcity due to cessation of production.

Wholesalers, jobbers, importers, retailers, and brokers of lard and lard substitutes are governed by special rules applying to licensed non-perishable food commodities. The maximum margins on sales by wholesalers to retailers is named as 1¼ ¢ to 2 ¢ per pound.[1]

[1] *United States Food Administration Laws and Rulings, Commerce Clearing House, Chicago, New York* (Chicago, Hillison and Etten Company, 1918).

APPENDIX F

TABLES

TABLE I.—COTTONSEED PRODUCED AND CRUSHED, CRUDE OIL PRODUCED, AND OIL EXPORTED, ANNUALLY, FROM 1874–75*

(Seed in thousand tons; oil in million pounds)

Year	Cottonseed produced	Cottonseed crushed	Percentage crushed	Crude oil produced	Oil exported	Percentage exported[a]
1874–75...	1,687	84	5.0	25	3.1	12.4
1875–76...	2,057	123	6.0	37	2.1	5.7
1876–77...	1,969	98	5.0	30	12.8	43.3
1877–78...	2,148	150	7.0	45	37.4	82.9
1878–79...	2,268	181	8.0	54	40.1	73.7
1879–80...	2,616	235	9.0	71	52.5	74.3
1880–81...	3,039	182	6.0	55	25.8	47.2
1881–82...	2,455	295	12.0	88	5.4	6.1
1882–83...	3,266	392	12.0	118	3.1	2.7
1883–84...	2,639	396	15.0	119	27.0	22.8
1884–85...	2,625	499	19.0	150	47.7	31.9
1885–86...	3,045	578	19.0	174	46.8	27.0
1886–87...	3,018	694	23.0	208	30.5	14.6
1887–88...	3,291	823	25.0	247	33.4	13.5
1888–89...	3,310	794	24.0	238	20.2	8.5
1889–90...	3,495	874	25.0	262	100.4	38.3
1890–91...	4,093	1,023	25.0	307	82.5	26.9
1891–92...	4,274	1,068	25.0	321	103.9	32.4
1892–93...	3,183	1,050	33.0	315	71.0	22.5
1893–94...	3,579	1,431	40.0	429	112.2	26.1

* Production data are official estimates for years ending July 31; export data are official data for years ending June 30; here taken mainly from Bureau of the Census, *Cotton Production and Distribution, Season of 1931–32* (Bulletin 169), 72, and *ibid., Seasons of 1932–33* (Bulletin 170), 36. A headnote to the table states that in its preparation "a number of sources of information have been utilized, but it has been found impracticable to secure in all instances satisfactory data for the years indicated, and only an approximation to the facts is claimed. . . . ." Exports include both crude and refined oil, for which separate statistics are available only from 1922 (see Table I *A*).

[a] These percentages are rendered slightly inaccurate by the lack of identity in 12-month periods covered by production and export data; they are also too low because a more or less considerable part consists of refined oil.

TABLE I (*Continued*)

Year	Cottonseed produced	Cottonseed crushed	Percentage crushed	Crude oil produced	Oil exported	Percentage exported[a]
1894–95...	4,792	1,677	35.0	503	158.9	31.6
1895–96...	3,416	1,435	42.0	430	145.8	33.9
1896–97...	4,070	1,628	40.0	488	204.0	41.8
1897–98...	5,253	2,101	40.0	630	301.7	47.9
1898–99...	5,472	2,353	43.0	706	379.7	53.8
1899–1900.	4,668	2,479	53.1	700	351.8	50.3
1900–01...	4,830	2,415	50.0	725	370.2	51.1
1901–02...	4,630	3,154	68.1	890	247.8	27.9
1902–03...	5,092	3,269	64.2	922	267.3	29.0
1903–04...	4,716	3,241	68.7	914	217.6	23.8
1904–05...	6,427	3,345	52.0	1,004	386.5	38.5
1905–06...	5,060	3,131	61.9	943	328.5	34.8
1906–07...	5,913	3,844	65.0	1,153	314.1	27.2
1907–08...	4,952	2,565	51.8	773	307.6	39.8
1908–09...	5,904	3,670	62.2	1,101	383.2	34.8
1909–10...	4,462	3,269	73.3	982	224.0	22.8
1910–11...	5,175	4,106	79.3	1,260	225.5	17.9
1911–12...	6,997	4,921	70.3	1,512	399.5	26.4
1912–13...	6,104	4,580	75.0	1,393	315.2	22.6
1913–14...	6,305	4,848	76.9	1,450	193.0	13.3
1914–15...	7,186	5,780	80.4	1,719	318.4	18.5
1915–16...	4,992	4,202	84.2	1,253	266.5	21.3
1916–17...	5,113	4,479	87.6	1,408	159.0	11.3
1917–18...	5,040	4,252	84.4	1,312	100.8	7.7
1918–19...	5,360	4,479	83.6	1,325	178.7	13.5
1919–20...	5,074	4,013	79.1	1,211	159.4	13.2
1920–21...	5,971	4,069	68.2	1,309	283.3	21.6
1921–22...	3,531	3,008	85.2	930	91.6	9.8
1922–23...	4,336	3,242	74.8	1,003	64.3	6.4
1923–24...	4,502	3,308	73.5	980	39.4	4.0
1924–25...	6,051	4,605	76.1	1,404	53.3	3.8
1925–26...	7,150	5,558	77.7	1,617	63.2	3.9
1926–27...	7,989	6,306	78.9	1,888	57.6	3.0
1927–28...	5,758	4,654	80.8	1,477	61.5	4.2
1928–29...	6,435	5,061	78.6	1,604	29.5	1.8
1929–30...	6,590	5,016	76.1	1,572	32.0	2.0
1930–31...	6,191	4,715	76.2	1,442	26.4	1.8
1931–32...	7,602	5,328	70.1	1,694	41.0	2.4
1932–33...	5,782	4,621	79.9	1,446	44.4	3.1

TABLE I *A*.—EXPORTS OF COTTONSEED OIL, CRUDE AND REFINED, 1922–33*

(Thousand pounds)

Calendar year	Crude	Refined	Total	Percentage crude	Percentage refined
1922	31,712	43,591	75,303	42.1	57.9
1923	27,782	21,826	49,608	56.0	44.0
1924	18,948	24,394	43,342	43.7	56.3
1925	33,553	28,862	62,415	53.8	46.2
1926	27,357	13,544	40,901	66.9	33.1
1927	51,407	16,575	67,982	75.6	24.4
1928	41,126	10,576	51,702	79.5	20.5
1929	19,292	67,783	26,075	74.0	26.0
1930	16,394	11,903	28,297	57.9	42.1
1931	9,733	12,845	22,578	43.1	56.9
1932	44,855	10,913	55,768	80.6	19.4
1933	26,143	9,392	35,535	73.6	26.4

* Basic data from *Commerce and Navigation of the United States.* Total and percentages computed from the other two columns. Data for 1933 are preliminary, direct from the Bureau of Foreign and Domestic Commerce.

TABLE II.—ASPEGREN ESTIMATES OF DOMESTIC USES OF COTTONSEED OIL, ANNUALLY FROM 1874–75 TO 1911–12*

(*Million pounds*)

Year Sept.-Aug.	Total	Soap making	Salad oil	Cooking and baking	Lard compound	Oleomargarine	Packing sardines	Other purposes
1874–75	15.4	10.0	4.0	...	...	...	...	1.4
1875–76	24.9	15.9	6.0	...	...	...	...	3.0
1876–77	10.1	1.2	6.0	...	...	...	...	2.9
1877–78	11.8	4.0	6.0	...	...	...	...	1.8
1878–79	8.1	4.0	3.2	...	...	...	...	0.9
1879–80	8.4	4.0	3.2	...	...	...	...	1.2
1880–81	18.9	7.9	4.0	...	4.0	2.0	...	1.0
1881–82	61.5	31.8	6.0	...	19.9	2.0	...	1.8
1882–83	103.3	47.8	7.9	2.0	39.8	4.0	...	1.8
1883–84	72.5	23.9	11.9	2.0	29.9	4.0	...	0.8
1884–85	70.4	19.9	8.0	2.0	29.8	6.0	2.0	2.7
1885–86	111.2	47.8	9.9	3.2	39.8	6.0	2.0	2.5
1886–87	150.0	63.7	9.9	3.2	59.7	8.0	3.2	2.4
1887–88	181.4	71.6	11.9	4.0	79.6	8.0	3.2	3.1
1888–89	195.0	79.6	11.9	4.0	79.6	9.9	4.0	6.0
1889–90	128.3	35.8	11.9	4.0	59.7	9.9	4.0	3.0
1890–91	188.4	51.7	11.9	4.8	99.5	11.9	2.0	6.6
1891–92	198.0	59.7	11.9	4.8	99.5	11.9	4.0	6.2
1892–93	177.9	35.8	13.9	4.8	99.5	13.9	4.0	6.0
1893–94	231.2	67.7	13.9	6.0	119.4	13.9	4.0	6.3
1894–95	322.2	71.6	15.9	6.0	199.0	15.9	6.0	7.8
1895–96	212.4	39.8	17.9	6.0	119.4	15.9	6.0	7.4
1896–97	277.6	43.8	19.9	7.9	171.1	19.9	6.0	9.0
1897–98	299.0	39.8	21.9	11.9	167.2	27.9	11.9	18.4
1898–99	298.1	39.8	29.8	13.9	179.1	19.9	6.0	9.6
1899–1900	359.2	47.8	31.8	15.9	238.8	10.0	6.0	8.9
1900–01	419.7	55.7	39.8	17.9	286.5	8.0	6.0	5.8
1901–02	722.5	131.3	51.7	33.8	477.6	8.0	6.0	14.1
1902–03	718.5	119.4	61.7	45.8	457.7	8.0	9.9	16.0
1903–04	810.8	129.4	95.5	59.7	437.8	6.0	13.9	68.5
1904–05	837.9	179.1	111.4	67.7	398.0	4.0	13.9	63.8
1905–06	797.6	119.4	107.5	79.6	437.8	4.0	11.9	37.4
1906–07	682.6	99.5	87.6	99.5	358.2	4.0	9.9	23.9
1907–08	477.6	79.6	59.7	79.6	238.8	2.0	8.0	9.9
1908–09	600.0	87.5	59.7	79.6	338.3	6.0	6.0	22.9
1909–10	887.8	159.2	79.6	159.2	398.0	15.9	8.0	67.9
1910–11	929.2	179.1	99.5	159.2	437.8	19.9	11.9	21.8
1911–12	936.7	179.1	79.6	179.1	445.8	27.9	11.9	13.3

* Data (converted from barrels at 398 pounds to the barrel) from Aspegren and Company, *Cotton Oil* (3d ed., New York, 1909, 6th ed., New York, 1913).

TABLE III.—ASPEGREN ESTIMATES OF USES OF EXPORTED COTTONSEED OIL, ANNUALLY FROM 1874–75 TO 1911–12*

(Barrels)

Year ending Aug. 31	As salad oil	For cooking and baking	For soap making	In compound lard	In artificial butter	For packing sardines and other fish	For other purposes	Total
1875.....	4,000	...	2,000	...	...	...	1,850	7,850
1876.....	2,500	...	1,500	...	...	200	1,110	5,300
1877.....	20,000	...	10,000	...	...	500	1,600	32,100
1878.....	50,000	...	35,000	...	500	750	7,550	93,800
1879.....	53,000	...	40,000	...	500	750	6,750	101,000
1880.....	60,000	500	60,000	...	1,000	1,000	9,100	131,600
1881.....	30,000	500	25,000	...	1,000	500	7,600	64,600
1882.....	6,000	300	5,700	...	800	200	400	13,400
1883.....	3,000	...	3,000	...	500	300	1,000	7,800
1884.....	35,000	500	25,000	500	1,000	500	5,300	67,800
1885.....	60,000	1,000	50,000	500	1,000	500	7,000	120,000
1886.....	60,000	1,000	48,000	500	1,000	500	6,600	117,600
1887.....	40,000	500	30,000	500	1,000	500	4,000	76,500
1888.....	44,000	500	34,000	500	1,000	500	4,200	84,700
1889.....	24,000	500	20,000	500	1,000	500	4,000	50,500
1890.....	150,000	2,000	80,000	2,000	5,000	1,500	10,500	251,000
1891.....	100,000	3,000	70,000	4,000	10,000	2,000	18,000	207,000
1892.....	120,000	4,000	100,000	6,000	15,000	3,000	13,000	261,000
1893.....	100,000	4,000	30,000	8,000	15,000	3,000	18,000	178,000
1894.....	100,000	5,000	120,000	10,000	20,000	4,000	22,000	281,000
1895.....	150,000	6,000	160,000	15,000	35,000	6,000	28,000	400,000
1896.....	130,000	7,000	140,000	20,000	40,000	7,000	22,000	366,000
1897.....	170,000	8,000	200,000	25,000	70,000	10,000	29,000	512,000
1898.....	200,000	9,000	220,000	30,000	150,000	15,000	32,000	756,000[a]
1899.....	300,000	10,000	400,000	50,000	150,000	20,000	32,000	962,000
1900.....	230,000	11,000	320,000	50,000	180,000	20,000	33,000	874,000[a]
1901.....	300,000	12,000	280,000	75,000	200,000	25,000	38,000	930,000
1902.....	160,000	13,000	50,000	60,000	100,000	20,000	20,000	423,000
1903.....	250,000	14,000	130,000	80,000	150,000	20,000	26,000	670,000
1904.....	220,000	15,000	90,000	80,000	150,000	30,000	25,000	600,000[a]
1905.....	360,000	16,000	200,000	100,000	250,000	30,000	44,000	1,000,000
1906.....	230,000	20,000	150,000	100,000	260,000	30,000	50,000	840,000
1907.....	220,000	25,000	140,000	100,000	235,000	20,000	60,000	800,000
1908.....	210,000	30,000	130,000	100,000	225,000	20,000	59,000	774,000
1909.....	350,000	35,000	170,000	140,000	250,000	30,000	19,000	994,000
1910.....	120,000	40,000	50,000	80,000	130,000	20,000	10,000	450,000
1911.....	180,000	45,000	100,000	90,000	120,000	20,000	9,000	564,000
1912.....	200,000	60,000	250,000	200,000	180,000	35,000	25,000	950,000

* Source as for Table II.

[a] Correct totals of items shown are 656,000 for 1898, 844,000 for 1900, and 610,000 for 1904. The errors may be in totals or in one or more components.

TABLE IV.—CLASSIFICATION OF TRADE-MARK REGISTRATIONS OF COMPOUND, 1868–1930*

Year	Number registered	Number of which use began	Year	Number registered	Number of which use began
1820 (?)	..	1	1901	3	3
1868	..	1	1902	5	11
			1903	9	15
1873	..	2	1904	6	2
1874	1	..	1905	4	3
1875	..	..	1906	9	10
1876	..	..	1907	9	7
1877	..	..	1908	12	5
1878	..	..	1909	1	4
1879	..	..	1910	4	5
1880	..	..			
			1911	5	3
1881	1	1	1912	4	1
1882	6	6	1913	3	10
1883	..	..	1914	8	10
1884	..	1	1915	9	6
1885	..	..	1916	12	8
1886	..	1	1917	14	10
1887	1	1	1918	9	15
1888	..	7	1919	16	11
1889	2	2	1920	12	19
1890	..	..			
			1921	22	18
1891	..	1	1922	10	9
1892	10	15	1923	12	4
1893	7	8	1924	10	5
1894	4	6	1925	18	8
1895	7	5	1926	5	4
1896	1	3	1927	2	5
1897	..	1	1928	14	8
1898	..	1	1929	8	5
1899	..	5	1930	7	2
1900	3	11			

* Based on list in Appendix D.

TABLE V.—EXPORTS OF COMPOUND, ANNUALLY FROM 1892–93, AND OF LARD, ANNUALLY FROM 1873–74*

Fiscal or Calendar Year	Thousand pounds		Thousand dollars		Average price (cents per pound)	
	Compound	Lard	Compound	Lard	Compound	Lard
1873–74.....	...[a]	205,527	...[a]	19,308	...	9.4
1874–75.....	...	166,869	...	22,901	...	13.7
1875–76.....	...	168,406	...	22,429	...	13.3
1876–77.....	...	234,741	...	25,563	...	10.9
1877–78.....	...	342,668	...	30,014	...	8.8
1878–79.....	...	326,659	...	22,857	...	7.0
1879–80.....	...	374,979	...	27,920	...	7.4
1880–81.....	...	378,142	...	35,227	...	9.3
1881–82.....	...	250,368	...	28,976	...	11.6
1882–83.....	...	224,718	...	26,618	...	11.8
1883–84.....	...	265,095	...	25,306	...	9.5
1884–85.....	...	283,216	...	22,595	...	8.0
1885–86.....	...	293,728	...	20,362	...	6.9
1886–87.....	...	321,534	...	22,704	...	7.1
1887–88.....	...	297,740	...	22,751	...	7.6
1888–89.....	...	318,243	...	27,329	...	8.6
1889–90.....	...	471,084	...	33,456	...	7.1
1890–91.....	...	498,344	...	34,414	...	6.9
1891–92.....	...	460,046	...	33,202	...	7.2
1892–93.....	912[b]	365,694	73[b]	34,644	8.0	9.5
1893–94.....	1,022[b]	447,567	78[b]	40,090	7.6	9.0
1894–95.....	504[b]	474,895	38[b]	36,822	7.6	7.8
1895–96.....	1,710[bc]	509,534	102[b]	33,590	6.0	6.6
1896–97.....	16,262[d]	568,316	858[d]	29,126	5.3	5.1
1897–98.....	21,343	709,344	1,119	39,711	5.2	5.6
1898–99.....	22,145	711,260	1,200	42,208	5.4	5.9
1899–1900...	25,853	661,814	1,475	41,939	5.7	6.3
1900–01.....	23,360	611,358	1,450	46,560	6.2	7.6
1901–02.....	36,202	556,840	2,688	52,376	7.4	9.4
1902–03.....	46,130	490,756	3,608	50,855	7.8	10.4

* Basic data from *Commerce and Navigation of the United States*, except for 1933, which are direct from the Bureau of Foreign and Domestic Commerce. Average prices are computed from the other two series. The figures for "lard" are exclusive of "neutral lard," which up to 1909–10 was included in "oleo oil and neutral lard," and since 1910–11 has been reported separately.

[a] Prior to 1892–93, exports of compound were presumably reported as lard.

[b] Cottolene and lardine only; see p. 97 for subdivision and comment.

[c] Erroneously given in later volumes as 500 less.

[d] From 1896–97 to 1907–08 the item read: "Lard compounds and substitutes for (cottolene, lardine, etc.)."

TABLE V (*Continued*)

Fiscal or Calendar Year	Thousand pounds		Thousand dollars		Average price (cents per pound)	
	Compound	Lard	Compound	Lard	Compound	Lard
1903–04	53,604	561,303	3,582	46,348	6.7	8.3
1904–05	61,215	610,239	3,613	47,243	5.9	7.7
1905–06	67,621	741,517	4,154	60,132	6.1	8.1
1906–07	80,149	627,560	6,167	57,498	7.7	9.2
1907–08	75,183	603,414	6,035	54,790	8.0	9.1
1908–09	75,183[e]	528,723	6,115[e]	52,713	8.1	10.0
1909–10	74,557	362,928	6,888	43,301	9.2	11.9
1910–11	73,754	476,108	7,071	52,509	9.6	11.0
1911–12	62,523	532,256	5,184	52,090	8.3	9.8
1912–13	67,457	519,025	5,916	58,187	8.8	11.2
1913–14	58,304	481,458	5,489	54,403	9.4	11.3
1914–15	69,981	475,532	6,046	52,440	8.6	11.0
1915–16	52,843	427,011	5,147	47,634	9.7	11.2
1916–17	56,359	444,770	8,270	77,009	14.7	17.3
1917–18	31,278	392,506	6,634	98,217	21.2	25.0
1918	43,977	548,818	10,259	144,933	23.3	26.4
1919	124,963	760,902	31,606	237,983	25.3	31.3
1920	32,051	612,250	7,219	143,371	22.5	23.4
1921	48,207	868,942	5,549	112,533	11.5	13.0
1922	41,764[f]	766,950	4,921[f]	91,485	11.8	11.9
1923	17,068	1,035,381	2,354	130,172	13.8	12.6
1924	14,371	994,095	1,999	125,728	13.9	12.6
1925	22,314	688,229	3,270	118,090	14.7	17.2
1926	18,167	698,961	2,582	108,600	14.2	15.5
1927	14,419	681,303	1,799	92,035	12.5	13.5
1928	10,394	759,722	1,373	98,701	13.2	13.0
1929	9,975	829,328	1,324	105,530	13.3	12.7
1930	8,790	642,486	1,136	73,434	12.9	11.4
1931	5,994	568,708	705	51,069	11.8	9.0
1932	3,498	546,202	301	31,885	8.6	5.8
1933	2,602[g]	579,072	226	34,095	8.7	5.9

[e] From 1908–09 to 1921 the item read: "Lard compounds and other substitutes for lard."

[f] From 1922 to 1932, this represents the sum of two items separately reported: "Lard compounds containing animal fats," and "vegetable oil lard compounds." See Table XVI for quantity of each, 1922–32.

[g] "Cooking fats other than lard."

TABLE VI.—EXPORTS OF COMPOUND TO PRINCIPAL AREAS OF REPORTED DESTINATION, ANNUALLY FROM 1896–97*

(*Thousand pounds*)

Year	Total	Europe	Northern North America	Mexico and Central America	West Indies, etc.	South America	All other countries
1896–97	16,262	15,284	11	418	412	104	33
1897–98	21,343	20,168	80	576	412	69	38
1898–99	22,145	18,315	195	913	374	1,033	1,315
1899–1900	25,853	19,673	394	684	556	1,404	3,142[a]
1900–01	23,360	18,508	577	754	1,639	645	1,237
1901–02	36,202	20,939	185	1,445	12,573	590	470
1902–03	46,130	26,388	642	1,812	14,437	2,029	822
1903–04	53,604	25,958	628	3,114	21,387	918	1,599
1904–05	61,215	27,392	518	4,455	23,208	475	5,167[b]
1905–06	67,621	37,505	804	10,015	17,478	696[c]	1,123
1906–07	80,149	38,091	676	11,681	27,018	790	1,893
1907–08	75,183	31,543	1,249	7,938	26,918	2,853	4,682[b]
1908–09	75,183	30,773	879	7,548	31,833	1,603	2,547[d]
1909–10	74,557	31,038	1,678	8,575	28,416	3,423	1,427
1910–11	73,754	26,225	2,228	9,784	30,302	3,040	2,175[e]
1911–12	62,523	22,903	1,132	9,249	23,044	2,069	4,126[f]
1912–13	67,457	25,225	651	7,157	23,912	4,503	6,009[f]
1913–14	58,304	24,161	927	5,190	20,875	2,753	4,398[f]
1914–15	69,981	33,179	883	5,961	24,502	2,074	3,382[f]
1915–16	52,843	21,617	415	7,850	17,775	2,788	2,398[f]
1916–17	56,359	21,077	843	10,276	20,416	1,447	2,300[g]
1917–18	31,278	12,646	293	6,067	10,497	953	822
1918	43,977	22,800	339	7,608	11,871	983	376
1919	124,963	103,157	748	5,641	13,832	1,105	480
1920	32,051	8,774	876	7,357	12,864	1,407	773
1921	48,207	19,524	1,087	11,706	14,972	245	673

* Based on data in *Commerce and Navigation of the United States.*

[a] Including 2,526 to British East Indies. In the four years following, exports to British East Indies averaged only 817.

[b] Including 4,364 and 1,919 to Straits Settlements for 1904–05 and 1907–08, respectively. In the latter year exports to Asiatic Russia and British South Africa also bulked relatively large.

[c] Prior to 1905–06 Brazil was in most years the chief single South American country of destination for compound exports. Thereafter exports to Brazil were negligible, and Chile and Colombia provided the principal South American markets in most years (Table VI *B*), though exports to Ecuador, Peru, and British Guiana were larger than exports to Colombia in some of the war and post-war years.

[d] Accounted for chiefly by exports to Straits Settlements, 610; Asiatic Russia, 302; British South Africa, 771; and French Africa, 176.

[e] Including 1,093 to British South Africa.

[f] Including relatively large exports to the Philippines (Table VI *B*); exports to Straits Settlements and British Africa were also relatively large in some years.

[g] Including relatively large exports to Japan, 411; Japanese leased territory in China, 704; and Asiatic Russia, 224.

TABLE VI (*Continued*)

Year	Total	Europe	Northern North America	Mexico and Central America	West Indies, etc.	South America	All other countries
1922.......	41,764	24,204[h]	538	7,021	9,282	183	536
1923.......	17,068	4,653	420	4,160	6,573	650	612
1924.......	14,371	3,145	578	3,098	6,549	359	642
1925.......	22,314	1,854	403	4,100	12,771	2,597	589
1926.......	18,167	2,652	764	3,735	8,587	1,769	660
1927.......	14,419	2,229	317	2,905	7,244	932	792
1928.......	10,394	1,329	362	3,125	3,733	700	1,145
1929.......	9,975	1,565	391	3,102	2,802	1,141	974
1930.......	8,790	2,028	650	2,113	2,175	1,046	778
1931.......	5,994	1,747	462	1,182	1,695	336	572
1932.......	3,498	698	172	702	1,199	337	390

[h] Including 10,450 to Russia in Europe, presumably largely for famine relief. In no other year have reported exports to Russia in Europe reached 1 million pounds, and in most of the post-war years the items have been negligible.

TABLE VI *A*.—EXPORTS OF COMPOUND TO PRINCIPAL EUROPEAN COUNTRIES OF REPORTED DESTINATION, ANNUALLY FROM 1896–97*

(*Thousand pounds*)

Year	United Kingdom	Denmark	Germany	lands Nether-	Belgium	France	Europe Other
1896–97......	4,295	917	3,924	250	743	4,619	536
1897–98......	6,331	1,130	5,495	4,244	431	2,159	378
1898–99......	5,694	1,204	5,685	2,954	619	1,282	877
1899–1900....	5,951	1,268	5,570	3,914	1,158	643	1,169
1900–01......	6,771	1,434	4,593	4,222	530	185	773
1901–02......	10,200	900	3,116	5,441	601	30	651
1902–03......	14,265	1,612	4,145	2,385	1,527	1,548	906
1903–04......	10,691	895	7,017	5,499	613	63	1,180
1904–05......	10,815	1,255	8,792	3,738	1,318	51	1,423
1905–06......	16,667	2,684	3,758	6,512	3,229	2,497	2,158
1906–07......	19,803	4,034	4,343	6,888	929	11	2,083
1907–08......	20,777	4,223	2,604	1,044	572	188	2,135
1908–09......	22,469	2,084	1,140	2,310	167	27	2,576[a]
1909–10......	26,425	606	1,038	706	113	64	2,086
1910–11......	18,827	309	4,005	1,266	1	85	1,732

* Data from *Commerce and Navigation of the United States.*

[a] Including 1,232 to Norway, an amount larger than usual, and also moderately large exports to European Russia, Sweden, and Italy, 986, 179, and 130, respectively.

TABLE VI *A* (*Continued*)

Year	United Kingdom	Denmark	Germany	Netherlands	Belgium	France	Other Europe
1911–12......	17,854	770	622	1,384	39	5	2,229
1912–13......	21,116	739	475	695	2	2	2,196
1913–14......	19,930	571	256	668	...	7	2,729[b]
1914–15......	26,357	1,376	258	1,353	299	189	3,347[b]
1915–16......	18,486	553	...	710	...	160	1,708[b]
1916–17......	13,508	65	...	295	5,810	34	1,365[b]
1917–18......	4,416	...	...	...	6,620	1,085	525[b]
1918	4,346	...	...	...	14,379	3,441	634
1919	62,739	585	1,229	887	22,645	630	14,442[c]
1920	4,009	159	1,747	212	452	2	2,193
1921	7,376	412	5,029	265	38	10	6,394[d]
1922	2,895	...	8,323	73	2	7	12,904[e]
1923	499	...	493	119	1	...	3,541
1924	457	10	2,120	14	161	28	355
1925	738	...	197	19	13	...	887
1926	1,000	...	341	585	138	10	578
1927	1,365	...	13	253	46	...	552
1928	380	...	71	126	3	52	697
1929	672	27	224	93	101	6	442
1930	1,397	23	137	23	47	4	397
1931	1,485	17	34	17	4	2	188
1932	476	...	51	52	5	2	112

[b] Norway was the principal single market among the group of countries from 1912–13 to 1916–17; Sweden took sizable quantities in 1914–15; and in 1917–18 Switzerland took the bulk of these exports.

[c] Including 9,320 to Gibraltar and 2,704 to Norway. Exports to European Russia, Italy, Sweden, Turkey, and Switzerland were also relatively large.

[d] Including 3,817 to Poland and Danzig.

[e] Including 10,450 to Russia in Europe, presumably largely for famine relief. In no other year have reported exports to Russia in Europe reached 1 million pounds, and in most of the post-war years the item has been negligible.

TABLE VI *B*.—EXPORTS OF COMPOUND TO PRINCIPAL EX-EUROPEAN COUNTRIES OF REPORTED DESTINATION, ANNUALLY FROM 1896–97*

(*Thousand pounds*)

Year	Mexico	Panama	Cuba	Haiti	British West Indies[a]	Chile	Colombia	Philippines
1896–97	395	...	246	11	83	...	24	...
1897–98	558	...	217	...	105	2	23	...
1898–99	799	...	131	31	118	296	71	...
1899–1900	579	...	375	41	87	391	14	3
1900–01	533	...	1,458	49	80	2	28	9
1901–02	1,019	...	12,395	28	115	...	87	...
1902–03	1,247	...	14,029	50	298	16	153	14
1903–04	2,325	113	20,655	27	480	58	152	...
1904–05	3,486	423	22,165	34	637	64	86	186
1905–06	6,946	2,119	15,056	255	1,060	237	133	73
1906–07	9,164	1,813	23,688	208	1,994	234	33	289
1907–08	5,867	1,049	22,466	296	2,722	1,205	250	232
1908–09	5,467	1,008	28,024	622	2,296	511	581	437
1909–10	5,768	1,397	24,379	1,265	2,581	1,365	288	160
1910–11	7,212	1,565	25,175	1,762	2,878	1,324	694	312
1911–12	6,769	1,762	17,214	2,261	2,970	559	855	2,621
1912–13	4,128	1,524	17,526	2,210	3,591	1,792	1,333	3,768
1913–14	3,119	1,333	14,673	1,670	3,923	1,411	579	2,596
1914–15	3,773	1,441	19,046	1,215	3,556	1,223	42	2,424
1915–16	4,598	2,203	11,895	1,812	3,381	2,320	18	1,584
1916–17	6,863	2,190	14,165	1,499	3,864	789	23	376
1917–18	4,442	1,055	7,735	262	1,751	363	2	621
1918	6,887	353	8,608	224	2,188	453	2	257
1919	4,620	414	8,611	1,604	2,727	111	3	247
1920	6,217	450	6,918	2,126	2,933	998	13	341
1921	10,213	731	8,116	2,412	3,391	27	8	308
1922	5,710	563	3,761	2,320	2,439	70	7	229
1923	2,820	366	2,269	2,529	1,092	225	74	208
1924	1,937	343	2,540	2,478	881	143	57	250
1925	2,798	477	8,561	2,606	737	844	52	162
1926	2,868	344	6,323	852	773	548	35	241
1927	1,838	416	5,070	641	814	390	38	267
1928	2,021	369	2,019	211	834	297	147	277
1929	1,847	423	1,068	65	955	379	297	236
1930	986	452	560	9	762	183	251	144
1931	231	402	150	11	561	90	156	140
1932	120	260	229	1	424	6	26	88

* Data from *Commerce and Navigation of the United States*.

[a] From 1910–11 (when exports to some of the British West Indies were first reported separately) to 1922, Trinidad and Tobago took over half the exports to the British West Indies. Thereafter the proportion taken by Trinidad and Tobago has been small; Jamaica and "Other British West Indies" have taken larger proportions.

TABLE VII.—SHIPMENTS OF COMPOUND AND LARD TO POSSESSIONS, ANNUALLY FROM 1896–97*

(*Thousand pounds*)

Year	Compound				Lard			
	Alaska	Hawaii	Puerto Rico	Total	Alaska	Hawaii	Puerto Rico	Total
1896–97	...	...	...[a]	...	...	...	4,573[a]	...
1897–98	...	...	2[a]	...	...	...	3,609[a]	...
1898–99	...	...	10[a]	...	...	...	4,742[a]	...
1899–1900	...	...	6[a]	...	...	...	5,984[a]	...
1900–01	...	...	121	...	...	...	4,086	...
1901–02	...	...	68	...	...	...	5,488	...
1902–03	13	159	2,148	2,320	278	688	3,791	4,757
1903–04	45	151	2,484	2,680	458	713	3,272	4,443
1904–05	59	536	3,618	4,213	594	320	3,841	4,755
1905–06	84	846	4,126	5,056	659	108	3,704	4,471
1906–07	98	789	5,231	6,118	630	170	3,106	3,906
1907–08	81	915	6,462	7,458	494	171	2,232	2,897
1908–09	105	1,303	6,865	8,273	726	154	1,941	2,821
1909–10	187	1,177	8,525	9,889	663	142	1,912	2,717
1910–11	159	1,167	9,041	10,367	426	157	2,190	2,773
1911–12	162	1,101	7,039	8,302	663	257	2,882	3,802
1912–13	207	1,305	8,668	10,180	584	309	3,013	3,906
1913–14	268	1,478	7,404	9,150	606	197	4,514	5,317
1914–15	...	1,576	7,425	9,001	616	354	3,685	4,655
1915–16	...	1,712	6,142	7,854	683	347	4,729	5,759
1916–17	...	1,561	7,734	9,295	930	481	3,625	5,036
1917–18	...	1,332	6,165	7,497	646	57	2,700	3,403
1918	...	1,409	6,313	7,722	304	33	2,800	3,217
1919	...	1,563	5,551	7,114	344	51	3,379	3,774
1920	...	1,313	5,103	6,416	396	41	6,524	6,961
1921	...	1,775	4,883	6,658	268	108	9,546	9,922
1922	...	1,813	5,231	7,044	409	376	9,195	9,980
1923	411	1,625	1,495	3,531	446	266	13,552	14,264
1924	224	1,224	2,593	4,041	471	228	13,740	14,439
1925	237	1,111	3,227[b]	4,575	379	109	10,984	11,472
1926	209	1,278	1,260[b]	2,747	389	131	15,559	16,079
1927	190[b]	1,397[b]	388[b]	1,975	408	154	14,952	15,514
1928	215[b]	2,430	1,882	4,527	391	280	17,336	18,007
1929	219[b]	2,402	1,594	4,215	370	184	17,937	18,491
1930	226[b]	3,090	1,467	4,783	372	145	17,705	18,222
1931	154[b]	3,230	1,311	4,695	347	209	21,991	22,547
1932	154[b]	3,543	682	4,379	352	159	23,224	23,735
1933	483[c]	3,415[c]	781[c]	4,679[c]	373	248	26,833	27,454

* Data from *Commerce and Navigation of the United States* and *Monthly Summary of Foreign Commerce of the United States*, except for 1933, which are direct from the Bureau of Foreign and Domestic Commerce. Shipments to Alaska and Hawaii prior to 1902–03 were presumably not reported in published documents. *Monthly Summary of Foreign Commerce of the United States*, December 1924, Pt. II, 97, which includes data for 1922–24, leads one to believe that figures for shipments of lard to Alaska for 1914–15 to 1922 may also include shipments of lard compounds.

[a] Included in "exports of domestic merchandise" through 1899–1900.

[b] Specifically designated as "lard compounds containing animal fats." Vegetable oil–lard compounds not reported separately; presumably included in "other vegetable oils and fats."

[c] "Cooking fats other than lard."

Table VIII.—Factory Production of Lard, Compound, and Cottonseed Oil, Quarterly, 1922–33*

(Million pounds)

Year	Jan.–Mar.	Apr.–June	July–Sept.	Oct.–Dec.	Jan.–Mar.	Apr.–June	July–Sept.	Oct.–Dec.
	Edible Lard (Other than Neutral Lard)				Lard Compounds and Other Lard Substitutes			
1922	416	397	341	421	188	146	207	243
1923	527	489	430	499	208	135	193	215
1924	591	509	402	433	178	181	192	279
1925	466	366	294	381	258	253	306	336
1926	446	403	367	363	289	271	242	339
1927	426	444	366	373	326	255	348	250
1928	593	430	317	460	307	237	302	297
1929	523	433	395	462	280	297	326	317
1930	451	405	336	383	280	283	317	331
1931	482	403	339	435	294	285	283	309
1932	487	405	343	437	221	221	277	227
1933	451	479	415	412	204	245	248	238
Average 1922–33	488	430	362	422	253	234	270	282
	Crude Cottonseed Oil				Refined Cottonseed Oil			
1922	267	44	118	505	283	87	58	398
1923	307	71	94	501	330	120	64	343
1924	290	96	117	652	276	166	92	523
1925	485	146	188	692	454	203	143	546
1926	568	163	172	857	501	190	100	680
1927	642	205	248	712	578	273	165	577
1928	434	95	159	773	406	169	109	647
1929	523	143	203	716	499	203	135	614
1930	499	153	239	725	447	215	160	636
1931	396	94	160	766	398	143	92	662
1932	523	222	248	577	456	273	167	486
1933	387	210	282	520	334	276	193	431
Average 1922–33	443	137	186	666	414	193	123	545

* Data from annual reports of the Bureau of Census, *Animal and Vegetable Fats and Oils*, and for 1933 preliminary quarterly reports, *Statistics of Fats and Oils*.

TABLE IX.—LARD PRODUCTION, EXPORTS, AND APPARENT DOMESTIC CONSUMPTION, 1900–32*

(Million pounds)

Calendar Year	Production			Exports[a]	Percentage exported[b]	Apparent consumption	
	Federally inspected	Other (estimated)	Total (estimated)			Total	Pounds per capita
1900.....	821[c]	796	1,617	615	38.0	1,002	13.2
1901.....	829[c]	785	1,614	612	37.9	1,002	12.9
1902.....	737[c]	702	1,439	507	35.2	932	11.7
1903.....	766[c]	730	1,496	541	36.2	955	11.8
1904.....	841[c]	755	1,596	571	35.8	1,025	12.4
1905.....	799[c]	752	1,551	708	45.6	843	10.0
1906.....	882[c]	762	1,644	685	41.7	959	11.2
1907.....	1,137	640	1,777	594	33.4	1,183	13.5
1908.....	1,171	619	1,790	587	32.8	1,203	13.5
1909.....	886	618	1,504	462	30.7	1,042	11.5
1910.....	792	642	1,434	382	26.6	1,052	11.4
1911.....	1,010	663	1,673	610	36.5	1,063	11.3
1912.....	965	661	1,626	558	34.3	1,068	11.2
1913.....	1,006	675	1,681	581	34.6	1,100	11.4
1914.....	969	688	1,657	465	28.1	1,192	12.2
1915.....	1,081	694	1,775	494	27.8	1,281	12.9
1916.....	1,159	690	1,849	463	25.0	1,368	13.6
1917.....	926	631	1,557	388	24.9	1,195	11.7
1918.....	1,260	723	1,983	559	28.2	1,374	13.3
1919.....	1,323	716	2,039	789	38.7	1,292	12.3

* Prepared for 1900–28 by John Roberts, in the Bureau of Animal Industry, Department of Agriculture, and published in mimeographed bulletins of that Bureau entitled *Meat Production, Consumption and Foreign Trade in United States. . . .* Methods used are explained in John Roberts, *Food Animals and Meat Consumption in the United States* (Department Circular 241), revised April 1929. Estimates for 1900–06, before federal inspection was in force, were made "with the co-operation of C. L. Harlan and other specialists of the Bureau of Agricultural Economics." From 1929 the Bureau of Agricultural Economics has continued the series, in preliminary mimeographed reports of *Statistics of Meat Production, Consumption and Foreign Trade of the United States. . . .* A revision of the series with the aid of 1930 census data is promised.

[a] Including neutral lard, and shipments to possessions. No imports are recorded.

[b] Computed by Food Research Institute.

[c] Estimated for comparison with later inspection data.

TABLE IX (*Continued*)

Calendar Year	Production			Exports[a]	Percentage exported[b]	Apparent consumption	
	Federally inspected	Other (estimated)	Total (estimated)			Total	Pounds per capita
1920.....	1,321	735	2,056	643	31.3	1,416	13.3
1921.....	1,379	735	2,114	903	42.7	1,223	11.3
1922.....	1,575	782	2,357	799	33.9	1,558	14.2
1923.....	1,971	812	2,783	1,075	38.6	1,707	15.3
1924.....	1,923	823	2,746	986	35.9	1,749	15.4
1925.....	1,452	771	2,223	719	32.3	1,522	13.2
1926.....	1,513	811	2,324	733	31.5	1,584	13.5
1927.....	1,557	799	2,356	717	30.4	1,634	13.8
1928.....	1,750	844	2,594	801	30.9	1,763	14.7
1929.....	1,763	835	2,598	866	33.3	1,735	14.3
1930.....	1,521	823	2,344	674	35.1	1,701	13.8
1931.....	1,554	831	2,385	601	25.2	1,784	14.4
1932.....	1,573	...	2,404[d]	576	24.0	.....	....
1933.....	1,679	...	2,510[d]	612	24.4	.....	....

[d] Preliminary, assuming lard not produced under Federal inspection in 1932 and 1933 was the same as in 1931. See *Fats and Oils, Statistics of United States Production, Trade, and Consumption* (Bureau of Agricultural Economics, March 1, 1934), Table 50.

TABLE X.—COMPOUND PRODUCTION, 1908–33, ACCORDING TO AVAILABLE DATA AND ESTIMATES*

(Thousand pounds)

Year	U.S. Dept. of Agriculture estimates[a]	U.S. Tariff Commission estimates[b]	Census quarterly reports[c]	Census of Manufactures[d]		U.S. Dept. of Agriculture: federally inspected[e]
				Total	By meat-packers	
1908...	....	....	....	....	....	436,448
1909...	....	....	....	....	....	488,249
1910...	....	....	....	....	....	671,526
1911...	....	....	....	....	....	672,845
1912...	876,927	....	....	....	....	648,443
1913...	....	....	....	....	....	670,802
1914...	1,136,522	....	....	(1,074,000)[f]	396,398	590,409
1915...	....	....	....	....	....	520,899
1916...	1,027,133	....	....	....	....	397,244
1917...	1,173,446	....	....	....	....	466,198
1918...	1,146,236	....	....	....	....	463,165
1919...	....	1,350,000	....	(1,352,000)[f]	521,122	469,732
1920...	....	747,255	....	....	....	328,567
1921...	....	811,095	....	(916,000)[f]	377,051	339,366
1922...	....	....	784,180	....	....	312,014
1923...	....	....	750,522	(783,000)[f]	287,735	336,843
1924...	....	....	830,435	....	....	363,180
1925...	....	....	1,152,600	1,129,390	450,922	458,518
1926...	....	....	1,140,708	....	....	543,913
1927...	....	....	1,178,995	1,239,087	438,037	535,175

* Sources as indicated in footnotes *a* to *e* below. The products covered constitute practically the same group throughout, though the name applied has been changed from time to time. "Lard substitute," "Lard compounds and other lard substitutes," "Lard substitutes and cooking fats," and "Shortenings other than lard" are the principal variants.

[a] Supplement to Bulletin No. 769 (Contribution from the Bureau of Chemistry), October 29, 1919, p. 6; compiled from data collected by the Fats and Oils Division of the U.S. Food Administration, chiefly in its fats and oils survey in 1917 and 1918.

[b] U.S. Tariff Commission, *Report to the Congress on Certain Vegetable Oils, Whale Oil, and Copra* (Report No. 41, Second Series, Washington, 1932), 159–60. Estimated for 1920 and 1921 on the basis of data obtained by questionnaire from producers of all types representing 80 per cent of the total lard-compound production. Cf. the same Commissioner's *Certain Vegetable Oils, Part 2 . . . .* (Washington, 1926), 161, for lower estimates for 1920–23.

[c] Bureau of the Census, *Animal and Vegetable Fats and Oils . . . .*; quarterly and annual data in annual reports, 1923–32.

[d] See Table XII.

[e] *Annual Report of the Chief of the Bureau of Animal Industry*, covering fiscal years ending June 30 of calendar years designated.

[f] Our computations from value data given in Table XII, using the unit value shown by data for the meat-packing industry. The results afford a rough check upon other quantity estimates for these years.

TABLE X (*Continued*)

Year	U.S. Dept. of Agriculture estimates[a]	U.S. Tariff Commission estimates[b]	Census quarterly reports[c]	Census of Manufactures[d]		U.S. Dept. of Agriculture: federally inspected[e]
				Total	By meat-packers	
1928...	....	....	1,143,349	....	....	472,604
1929...	....	....	1,220,102	1,256,836	405,150	467,077
1930...	....	....	1,211,268	....	....	433,495
1931...	....	....	1,171,559	1,207,858	348,574	482,482
1932...	....	....	945,441	....	....	411,935
1933...	....	....	934,808[g]	....	....	322,146

[g] Preliminary.

TABLE XI.—COMPOUND AND LARD PRODUCTION IN THE MEAT-PACKING INDUSTRY, COMPARED WITH TOTAL OUTPUT OF THE INDUSTRY, CENSUS YEARS, 1899–1931*

Census year	Production (million dollars)				Percentage of total			Percentage of compound to lard and compound
	Compound[a]	Lard	Lard and compound	All products	Compound[a]	Lard	Lard and compound	
1899...	....	61.1[b]	.....	784	...	7.8[b]	...	....
1904...	....	82.5[b]	.....	914	...	9.0[b]	...	....
1909...	....	134.4[b]	.....	1,356	...	9.9[b]	...	....
1914...	33.0	120.4	153.4	1,652	2.0	7.3	9.3	21.5
1919...	123.7	415.8	539.5	4,246	2.9	9.8	12.7	22.9
1921...	39.7	190.4	230.1	2,201	1.8	8.7	10.5	17.3
1923...	37.2	263.9	301.1	2,586	1.4	10.2	11.6	12.4
1925...	59.6	279.6	339.2	3,050	1.9	9.2	11.1	17.6
1927...	50.3	234.9	285.2	3,057	1.6	7.7	9.3	17.6
1929...	46.9	248.0	294.9	3,435	1.4	7.2	8.6	15.9
1931...	31.3[c]	149.4[d]	180.7[e]	2,177[d]	1.4	6.9	8.3	21.1

* Basic data from *Census of Manufactures, 1914*, II, 318, 333; *Fourteenth Census of the United States (1920)*, X, *Manufactures*, 46, 56; *Biennial Census of Manufactures, 1921*, pp. 124, 128; *ibid., 1923*, pp. 141, 144; *ibid., 1925*, pp. 158, 183, 187; *ibid., 1927*, pp. 150, 173, 175; *Fifteenth Census of the United States, Manufactures (1929)*, II, 176–77; and mimeographed releases of the Bureau of the Census. Where figures first published were altered in subsequent reports, the latest source has been used.

[a] See Table XII, footnote *, for designations in successive reports.

[b] Before compound production was separately reported, all or part of the compound manufactured was probably reported under lard.

[c] Data from condensed final report of the preliminary report of November 4, 1932.

[d] Data from preliminary report issued December 17, 1932.

[e] Sum of two columns preceding.

TABLE XII.—CENSUS OF MANUFACTURES DATA ON PRODUCTION OF COMPOUND, 1914–31*

Year[a]	Meat-packing industry	All other industries	Shortening (ex-lard) industry	Other industries	Total reported
	Quantity Produced (*thousand pounds*)				
1914	396,398[b]	(677,000)	(572,000)	(105,000)	(1,074,000)
1919	521,122	(831,000)	(511,000)[c]	(320,000)	(1,352,000)
1921	377,054	(539,000)	(318,000)[c]	(221,000)	(916,000)
1923	287,735	(495,000)	(328,000)[d]	(167,000)[d]	(783,000)
1925	450,880	678,510	622,795[d]	55,715[d]	1,129,390
1927	438,037	801,050	775,006	26,044	1,239,087
1929	405,150	851,686	832,354	19,332	1,256,836
1931	364,271[e]	843,587[e]	833,291[e]	10,296[e]	1,207,858[e]

* *Census of Manufactures, 1914*, II, 333–34; *ibid., 1919*, pp. 56–57; *Biennial Census of Manufactures, 1921*, pp. 128–29; *ibid., 1923*, pp. 144–45; *ibid., 1925*, pp. 158, 187; *ibid., 1927*, pp. 150, 176; and mimeographed releases of the Bureau of the Census. Average f.o.b. factory prices are computed from the two published series. Figures in parentheses are our calculations from value data shown and the average prices for corresponding years indicated by data for the meat-packing industry.

What we have here termed simply "Compound" has been variously designated, apparently without change in scope or connotation, as follows: "Lard compounds and substitutes"—1914, 1919; "Lard compounds and other lard substitutes"—1921, 1923; "Lard substitutes and cooking fats"—1925, 1927, 1929; "Shortenings (other than lard)"—1931.

Because of changes in classification of establishments (see footnotes *c* and *d* below), the figures in the third and fourth columns are less comparable prior to 1927 than their sum here shown in the second column.

[a] The figures shown do not relate precisely to the calendar year, for some establishments elect to report for their fiscal year conforming most closely to the calendar year. Hence quantity totals shown by the Census of Manufactures should not agree with those of the quarterly census of animal and vegetable fats and oils in Table X.

[b] The data for 1914 are presumably incomplete, even for meat-packers. The note which introduces the tabulation in which the value data appear reads in part:

"Many establishments in the slaughtering and meat-packing industry make large quantities of subsidiary products, some of which form the chief product of other industries distinguished by the census. A number of the large concerns kept separate accounts and made separate reports for the branches or departments making certain of these subsidiary products, such as soap; fertilizers; lard compound and substitutes; . . . ."

[c] A footnote to the census table for 1919 states that the total for industries "engaged primarily in manufacturing the product specified . . . . includes in some cases products other than those specified." A similar note appears for 1921, and it may hold for other years as well.

[d] For 1923 and 1925, a footnote to this heading, there called "Establishments in other classifications," states that, "because of changes in classification, this figure is not comparable with those published for previous years." The same certainly applies also to 1927, when for the first time "establishments engaged primarily in the manufacture of vegetable cooking oils, most of which were formerly assigned to the 'Oils, not elsewhere classified' industry," were included in the "Lard substitutes and vegetable cooking oils" industry (previously the "Lard substitutes and cooking fats" industry). Figures for the years 1927–31 are presumably fully comparable, despite the change of name in 1931 to the "Shortenings (other than lard), vegetable cooking oils, and salad oils" industry.

[e] Preliminary data.

TABLE XII (*Continued*)

Year[a]	Meat-packing industry	All other industries	Shortening (ex-lard) industry	Other industries	Total reported
	VALUE OF PRODUCT (*thousand dollars*)				
1914	33,037[b]	56,404	47,662	8,742	89,441
1919	123,724	197,165	121,249[c]	75,916	320,889
1921	39,706	56,718	33,488[c]	23,230	96,424
1923	37,198	64,077	42,488[d]	21,589[d]	101,275
1925	59,563	88,008	81,051[d]	6,957[d]	147,571
1927	50,331	92,246	89,320	2,926	142,577
1929	46,938	100,714	98,341	2,373	147,652
1931	31,340[e]	74,840[e]	73,807[e]	1,033[e]	106,180[e]
	AVERAGE F.O.B. FACTORY PRICE (*cents per pound*)				
1914	8.33	.....	.....	.....	.....
1919	23.74	.....	.....	.....	.....
1921	10.53	.....	.....	.....	.....
1923	12.93	.....	.....	.....	.....
1925	13.21	12.97	13.01	12.49	13.07
1927	11.49	11.52	11.53	11.23	11.51
1929	11.59	11.83	11.81	12.27	11.75
1931	8.60	8.87	8.86	10.03	8.79

TABLE XIII.—CENSUS OF MANUFACTURES CLASSIFIED DATA ON COMPOUND PRODUCED IN THE SHORTENINGS (OTHER THAN LARD) INDUSTRY, 1925–31*

Year	Package goods, 8 pounds and under			Other, over 8 pounds			Total from vegetable oils and fats only	Total from animal and vegetable oils and fats
	From vegetable oils and fats only	From animal and vegetable oils and fats	Total	From vegetable oils and fats only	From animal and vegetable oils and fats	Total		
	QUANTITY (*thousand pounds*)							
1925	126,381	77,040	(203,421)	264,122	155,252	(419,374)	390,503	232,292
1927	205,144	80,580	(285,724)	332,194	157,088	(489,282)	537,338	237,668
1929	212,629	70,840	(283,469)	445,842	103,043	(548,885)	658,471	173,883
1931	218,768	106,248	(325,015)	381,405	126,870	(508,275)	600,173	233,118
	VALUE (*thousand dollars*)							
1925	17,298	10,626	(27,924)	33,386	19,741	(53,127)	50,684	30,367
1927	26,019	10,159	(36,178)	35,838	17,304	(53,142)	61,857	27,463
1929	27,700	8,762	(36,462)	50,467	11,412	(61,879)	78,167	20,174
1931	21,804	9,646	(31,450)	32,068	10,289	(42,357)	53,872	19,935
	AVERAGE F.O.B. FACTORY PRICE (*cents per pound*)							
1925	13.7	13.8	13.7	12.6	12.7	12.7	13.0	13.0
1927	12.7	12.6	12.7	10.8	11.0	10.9	11.5	11.6
1929	13.0	12.4	12.9	11.3	11.1	11.3	11.9	11.6
1931	10.0	9.1	9.7	8.4	8.1	8.3	9.0	8.6

* See Table XII, footnote *, for sources and its footnote *d* for lack of comparability of 1925 data with those for subsequent years. No corresponding data are available before 1925.

TABLE XIV.—SHORTENING MATERIALS USED IN THE COMMERCIAL BAKING INDUSTRY, CENSUS YEARS 1923–31*

Year	Total	Butter and substitutes	All other shortenings	Lard	Other shortening	Lard substitutes
	QUANTITY (*million pounds*)					
1923........	423.2	33.4[a]	389.8	271.3	118.5	....
1925........	398.9	30.1	368.8	....	....	....
1927........	450.5	46.8	403.7	176.7	227.0	133.6
1929........	562.8	50.1	512.7	253.4	259.3	117.8
1931........	509.6	48.4	461.2	219.8	241.4	....
	COST (*thousand dollars*)					
1923........	64,791	13,419[a]	51,372	35,238	16,134	....
1925........	65,875	11,508	54,367	....	....	....
1927........	70,245	14,869	55,376	25,837	29,539	17,365
1929........	79,267	16,005	63,262	30,947	32,315	14,741
1931........	51,978	10,382	41,596	19,459	22,137	....
	AVERAGE COST PER POUND (*cents*)					
1923........	15.3	40.1	13.2	13.0	13.6	....
1925........	16.5	38.2	14.7	....	....	....
1927........	15.6	31.8	13.7	14.6	13.0	13.0
1929........	14.1	31.9	12.3	12.2	12.5	12.5
1931........	10.2	21.5	9.0	8.9	9.2	....
	PERCENTAGE OF TOTAL QUANTITY OF SHORTENING USED					
1923........	....	7.9	92.1	64.1	28.0	....
1925........	....	7.5	92.5	....	....	....
1927........	....	10.4	89.6	39.2	50.4	29.7
1929........	....	8.9	91.1	45.0	46.1	20.9
1931........	....	9.5	90.5	43.1	47.4	....

* Sources cited under Table XIV.

[a] Butter only.

TABLE XIII.—CENSUS OF MANUFACTURES CLASSIFIED DATA ON COMPOUND PRODUCED IN THE SHORTENINGS (OTHER THAN LARD) INDUSTRY, 1925–31*

Year	Package goods, 8 pounds and under			Other, over 8 pounds			Total from vegetable oils and fats only	Total from animal and vegetable oils and fats
	From vegetable oils and fats only	From animal and vegetable oils and fats	Total	From vegetable oils and fats only	From animal and vegetable oils and fats	Total		
	QUANTITY (*thousand pounds*)							
1925	126,381	77,040	(203,421)	264,122	155,252	(419,374)	390,503	232,292
1927	205,144	80,580	(285,724)	332,194	157,088	(489,282)	537,338	237,668
1929	212,629	70,840	(283,469)	445,842	103,043	(548,885)	658,471	173,883
1931	218,768	106,248	(325,015)	381,405	126,870	(508,275)	600,173	233,118
	VALUE (*thousand dollars*)							
1925	17,298	10,626	(27,924)	33,386	19,741	(53,127)	50,684	30,367
1927	26,019	10,159	(36,178)	35,838	17,304	(53,142)	61,857	27,463
1929	27,700	8,762	(36,462)	50,467	11,412	(61,879)	78,167	20,174
1931	21,804	9,646	(31,450)	32,068	10,289	(42,357)	53,872	19,935
	AVERAGE F.O.B. FACTORY PRICE (*cents per pound*)							
1925	13.7	13.8	13.7	12.6	12.7	12.7	13.0	13.0
1927	12.7	12.6	12.7	10.8	11.0	10.9	11.5	11.6
1929	13.0	12.4	12.9	11.3	11.1	11.3	11.9	11.6
1931	10.0	9.1	9.7	8.4	8.1	8.3	9.0	8.6

* See Table XII, footnote *, for sources and its footnote *d* for lack of comparability of 1925 data with those for subsequent years. No corresponding data are available before 1925.

TABLE XIV.—SHORTENING MATERIALS USED IN THE COMMERCIAL BAKING INDUSTRY, CENSUS YEARS 1923–31*

Year	Total	Butter and substitutes	All other shortenings	Lard	Other shortening	Lard substitutes
	QUANTITY (*million pounds*)					
1923........	423.2	33.4[a]	389.8	271.3	118.5	....
1925........	398.9	30.1	368.8	....	....	....
1927........	450.5	46.8	403.7	176.7	227.0	133.6
1929........	562.8	50.1	512.7	253.4	259.3	117.8
1931........	509.6	48.4	461.2	219.8	241.4	....
	COST (*thousand dollars*)					
1923........	64,791	13,419[a]	51,372	35,238	16,134	....
1925........	65,875	11,508	54,367	....	....	....
1927........	70,245	14,869	55,376	25,837	29,539	17,365
1929........	79,267	16,005	63,262	30,947	32,315	14,741
1931........	51,978	10,382	41,596	19,459	22,137	....
	AVERAGE COST PER POUND (*cents*)					
1923........	15.3	40.1	13.2	13.0	13.6	....
1925........	16.5	38.2	14.7	....	....	....
1927........	15.6	31.8	13.7	14.6	13.0	13.0
1929........	14.1	31.9	12.3	12.2	12.5	12.5
1931........	10.2	21.5	9.0	8.9	9.2	....
	PERCENTAGE OF TOTAL QUANTITY OF SHORTENING USED					
1923........	....	7.9	92.1	64.1	28.0	....
1925........	....	7.5	92.5	....	....	....
1927........	....	10.4	89.6	39.2	50.4	29.7
1929........	....	8.9	91.1	45.0	46.1	20.9
1931........	....	9.5	90.5	43.1	47.4	....

* Sources cited under Table XIV.

[a] Butter only.

TABLE XV.—COST OF PRINCIPAL MATERIALS USED IN THE COMMERCIAL BAKING INDUSTRY, CENSUS YEARS 1923–31*

(Thousand dollars, except as noted)

Materials	1923	1925	1927	1929	1931
Flour	233,859	272,227	271,924	277,820	164,800
Sugar	61,448	40,707	48,536	52,701	39,511
Eggs	21,702	29,950	31,685	42,770	26,093
Milk	22.919	18,940	21,862	26,735	17,557
Yeast	18,828	16,404	17,917	20,104	18,094
Butter and substitutes	13,419[a]	11,508	14,869	16,005	10,382
Lard	35,238		25,837	30,947	19,459
Lard substitutes	16,134[b]	54,367	17,365	14,741	22,137
Other shortenings			12,174	17,574	
Total shortenings	64,791	65,875	70,245	79,267	51,978
Comparable total	423,547	444,103	462,169	498,397	318,033
Fruits and nuts	18,761	.....	.....	.....	.....
Chocolate and cocoa	4,109	.....	.....	.....	.....
Malt extract	.....	2,968	3,172	3,601	2,855
All other	37,550	45,297	.....	.....	.....
Reported total	483,967	492,369	.....	.....	.....
Cost of shortenings as percentage of—					
Comparable totals	15.3	14.8	15.2	15.9	16.3
Reported totals	13.4	13.4	.....	.....	.....
Percentage of total value of output produced by plants reporting above details	80.6	86.4	87.9	90.8	85.3

* Basic data from *Biennial Census of Manufactures, 1923,* p. 38; *ibid.,* 1925, p. 43; *ibid.,* 1927, p. 40; and *Fifteenth Census of the United States* (1930), *Manufactures (1929),* II, 59–60; Census of Manufactures, 1931, *Bread and Other Bakery Products . . . .,* 10. No corresponding data available prior to 1923.

[a] Butter only.

[b] Presumably including butter substitutes.

TABLE XVI.—RELATIVE IMPORTANCE OF VEGETABLE OIL COMPOUNDS AND COMPOUNDS CONTAINING ANIMAL FATS IN EXPORTS, 1922–32, AND IN PRODUCTION IN PART OF THE INDUSTRY, CENSUS YEARS 1925–31*

Calendar year	Thousand pounds			Percentage of total	
	Vegetable oil compound	Containing animal fats	Total	Vegetable oil compound	Containing animal fats
	EXPORTS OF COMPOUND				
1922	25,478	16,286	41,764	61.0	39.0
1923	9,617	7,451	17,068	56.3	43.7
1924	6,989	7,382	14,371	48.6	51.4
1925	8,223	14,091	23,314	36.9	63.1
1926	7,586	10,581	18,167	41.8	58.2
1927	5,431	8,988	14,419	37.7	62.3
1928	5,681	4,713	10,394	54.7	45.3
1929	6,343	3,632	9,975	63.6	36.4
1930	6,354	2,436	8,790	72.3	27.7
1931	4,348	1,646	5,994	72.5	27.5
1932	2,404	1,094	3,498	68.7	31.3
	PRODUCTION IN SHORTENINGS (OTHER THAN LARD) INDUSTRY ONLY				
1925	390,503	232,292	622,795	62.7	37.3
1927	537,338	237,668	775,006	69.3	30.7
1929	658,471	173,883	832,354	79.1	20.9
1931	600,173	233,117	833,291	72.0	28.0

* Export data from *Foreign Commerce and Navigation of the United States;* production data from sources noted in Table XII, the footnotes to which give certain explanations affecting the comparability of 1925 data with those for 1927–31 and indicate that 1931 data are preliminary.

TABLE XVII.—RAW MATERIALS USED IN MANUFACTURE OF COMPOUND, IN SPECIFIED YEARS, 1912–33*

Calendar year	Materials used (million pounds)				Percentages of total		
	Cottonseed oil	Other vegetable oils	Animal fats and oils	Total	Cottonseed oil	Other vegetable oils	Animal fats and oils
1912	866.7	8.3	69.7	944.7	91.7	0.9	7.4
1914	1,053.1	9.9	80.2	1,143.2	92.2	0.8	7.0
1916	919.4	63.5	60.4	1,043.3	88.1	6.2	5.7
1917	1,069.2	87.0	65.9	1,222.1	87.5	7.1	5.4
1918	1,015.1	139.5	67.8	1,222.4	83.0	11.4	5.6
1920	605.3	89.4	61.5	756.2	80.1	11.8	8.1
1921	709.1	37.3	72.2	818.6	86.6	4.6	8.8
1922	655.7	49.3	68.9	773.9	84.7	6.3	9.0
1923	640.6	40.9	76.4	757.9	84.5	5.4	10.1
1929	1,083.2[a]	21.6	115.3	1,220.1[b]	88.8[a]	1.8	9.4
1931	928.5	144.6	135.0	1,280.1	76.9	12.0	11.1
1932	834.4	50.7	83.5	968.6	86.2	5.2	8.6
1933	852.8	43.0	76.3	972.1	87.7	4.4	7.9

* Retabulated from data assembled in U.S. Tariff Commission, *Report to the Congress on Certain Vegetable Oils, Whale Oil, and Copra* (Report No. 41, Second Series, Washington, 1932), 159–61, giving sources and qualifications partially discussed above, p. 117, and in footnotes to Table XVIII, with 1931, 1932, and 1933 data from annual mimeographed releases of the Census Bureau, "Factory Consumption of Animal and Vegetable Fats and Oils by Classes of Products" for 1931, 1932, and 1933.

[a] "Obtained by subtracting from the lard-compound production in 1929 the estimated consumption of other oils used in their manufacture." This may result in a slight understatement of the total. Since, however, the estimates of quantities of other vegetable oils used may be too low (see footnotes to Table XVIII), the figure for cottonseed oils may be too high, in percentage terms at least.

[b] Production of compound as reported by Bureau of the Census, *Animal and Vegetable Fats and Oils. . . .*

TABLE XVIII. — ANIMAL AND VEGETABLE FATS AND OILS (OTHER THAN COTTONSEED OIL) USED IN MANUFACTURE OF COMPOUND, IN SPECIFIED YEARS, 1912–33*

(*Thousand pounds*)

Calendar year	Tallow, edible	Oleostearin	Oleo oil	Pork fat and lard	Fish oils
1912	10,834	57,644	.....	1,200	.....
1914	13,945	64,926	.....	1,290	.....
1916	9,852	49,493	.....	1,069	.....
1917	9,953	54,959	.....	1,004	.....
1918	11,361	54,598	.....	1,850	.....
1920	9,925	41,871	97	9,604	.....
1921	10,142	46,779	235	15,042	.....
1922	10,683	43,916	2,791	11,489	.....
1923	23,408	43,075	2,655	7,066	.....
1929	25,556	44,138	7,553	23,123	14,921
1931	69,548	27,220	10,004	8,860	19,384
1932	45,708	17,357	1,134	5,636	13,705
1933	46,437	17,105	294	3,171	9,272

Calendar year	Peanut oil	Soy bean oil	Corn oil	Coconut oil	Other oils[a]
1912	1,687	.....	.....	.....	6,598
1914	2,144	1,585	.....	.....	6,158
1916	17,869	14,247	13,105	.....	30,715
1917	12,209	34,351	4,166	5,545	12,742
1918	27,912	56,517	2,288	13,408	39,426

* Sources as for Table XVII. See text, pp. 119, 125, for corresponding percentages of total materials used. Fish oils include marine animal oils, such as whale oil.

[a] Including vegetable stearin (1912—180; 1914—611; 1916—4,007; 1917—17,140; 1918—14,904), palm oil, sesame oil; also hydrogenated oils as follows: 1914—83; 1916—778; 1917—833; 1918—18,172. The last, according to Department of Agriculture Bulletin 769, Supplement, p. 6, "represent largely the amount of hydrogenated oil purchased by the smaller substitute makers for combining with the other ingredients."

TABLE XVIII (*Continued*)

Calendar year	Peanut oil	Soy bean oil	Corn oil	Coconut oil	Other oils[a]
1920	48,209	17,607	7,095	9,714	6,720
1921	15,761	8,166	2,960	3,014	7,449
1922	9,841	.....	14,200	16,099	9,149
1923	3,813	681	6,721	21,205	8,404
1929	.....[b]	.....	.....[b]	20,000[c]	1,608[d]
1931	5,960	10,869	6,616	34,132	87,060[e]
1932	3,502	4,889	3,067	8,332	30,880[f]
1933	3,330	489	1,128	7,112	30,956[g]

[b] "Peanut and corn oils shown by the Bureau of the Census as used in 1929 in food industries other than the margarine industry were regarded as used solely in making salads and table oil. This involves a slight error, for it is probable that small but indeterminate quantities of these oils were used in lard compounds."

[c] "From the quantities of coconut and palm-kernel oils shown by the Bureau of the Census as consumed in 1929 in food industries other than margarine, there were deducted sales of these oils to the confectionery and baking trades by six leading refiners. The remainder, which is the figure given, is probably only a slight overstatement of the consumption of those oils in lard compounds."

[d] Including palm oil, 1,191. "Palm oil shown by the Bureau of the Census as used in 1929 in food industries other than the margarine was taken as used entirely in lard compounds. An estimate made by one of the leaders in the trade showed 10,000,000 instead of a little over 1,000,000 pounds." The Tariff Commission's report, cited above, gives on p. 31 a figure of 5.2 million pounds of sesame oil for 1929; but this does not appear in the table on p. 160 from which the above data are taken.

[e] Including palm oil, 34,536; sesame oil, 33,817; palm-kernel oil, 158; other, 18,549.

[f] Including palm oil, 22,126; sesame oil, 7,797; other, 957.

[g] Including palm oil, 21,116; sesame oil, 7,371; and sunflower oil, 2,469.

TABLE XIX.—TARIFF DUTIES ON FATS AND OILS AND THEIR FOOD PRODUCTS, 1883–1932*

(Cents per pound)

Date effective	Lard	Lard compounds	Oleostearin	Cottonseed oil	Peanut oil	Soy bean oil	Coconut oil[a]
1882, July 1......	2.0	...	...	3.3[b]	...	...	free
1890, Oct. 6.....	2.0	...	...	1.3[b]	...	...	free
1894, Aug. 1.....	1.0	...	...[c]	free	...[d]	...	free
1897, July 25.....	2.0	...	...[c]	0.5[b]	...[d]	...	free
1909, Aug. 6.....	1.5	...	free	free	free	free	free
1913, Oct. 4.....	free	free	free	free	0.8[e]	free	free
1921, May 28.....	free	free	...	2.7[b]	3.5[f]	2.7[b]	2.7[b]
1922, Sept. 22...	1.0	4.0	1.0	3.0	4.0	2.5	2.0
1930, June 15....	3.0	5.0	1.0	3.0	4.0	3.5[g]	2.0

* Basic data from *United States Statutes at Large*, XXII, 491–526; XXVI, 567–617; XXVIII, 509–71; XXX, 151–213; XXXVI, Pt. I, 11–118; XXXVIII, Pt. I, 114–66; XLII, Pt. I, 9–11, 858–990; XLVI, Pt. I, 590–763. Palm oil and vegetable tallow, and copra, palm nuts, palm kernel nuts, and sesame seed have been duty-free throughout. Under the Act of 1930 duties are imposed on cottonseed, peanuts (shelled and unshelled), and soy beans (prepared and unprepared). Additional fats and oils dutiable under the Act of 1930 are:

	Cents per pound
Palm kernel oil, edible.......	1.0
Sesame oil, edible............	3.0
Animal tallow	0.5

	Cents per gallon
Cod, herring, and menhaden oil	5.0
Whale and seal oil..........	6.0
Sperm oil, crude............	10.0
Sperm oil, refined...........	14.0

Under the Act of 1930, unspecified animal and fish oils, and unspecified expressed or extracted vegetable oils, are dutiable at 20 per cent ad valorem.

[a] Crude or refined. The duty does not apply to imports from the Philippine Islands. Copra has always been admitted duty-free.

[b] Expressed in the Tariff Act in cents per gallon: 1883—25; 1890—10; 1897—4; 1921—20.

[c] Under the Tariff Act of 1894, oleostearin was dutiable as a non-enumerated manufactured article, and not free under Paragraph 645 as tallow, according to Treasury Decision No. 16534 (G.A. 3252), in *Compilation of Customs Laws and Digest of Decisions Thereunder*, 1908, p. 848.

[d] Not enumerated, but presumably free under "other nut oils."

[e] Expressed as 6 cents per gallon; also rapeseed oil.

[f] Expressed as 26 cents per gallon.

[g] ". . . but not less than 45 per centum ad valorem."

TABLE XX.—APPROXIMATE PER CAPITA CONSUMPTION OF LARD, COMPOUND, BUTTER, AND MARGARINE, ANNUALLY, 1900–32*

(Pounds)

Year	Lard	Compound	Lard and compound	Butter and margarine[a]	Butter	Margarine[b]	Four fats[a]
1900........	13.2	....	....	20.9	19.6	1.4	....
1901........	12.9	....	....	21.0	19.6	1.3	....
1902........	11.7	....	....	19.5	18.3	1.5	....
1903........	11.8	....	....	20.2	19.5	0.8	....
1904........	12.4	....	....	19.7	19.2	0.5	....
1905........	10.0	....	....	21.0	20.5	0.5	....
1906........	11.2	....	....	19.7	19.1	0.5	....
1907........	13.5	....	....	18.2	17.4	0.8	....
1908........	13.5	....	....	19.5	18.6	0.9	....
1909........	11.5	....	....	19.1	17.8	1.0	....
1910........	11.4	....	....	18.2	16.8	1.5	....
1911........	11.3	....	....	18.2	16.9	1.3	....
1912........	11.2	8.3[c]	19.5[c]	18.0	16.6	1.3	37.5[c]
1913........	11.3	....	....	18.0	16.5	1.5	....
1914........	12.0	10.8	22.8	18.4	17.0	1.4	41.2
1915........	12.8	....	....	18.7	17.3	1.4	....
1916........	13.6	9.5	23.1	19.2	17.5	1.5	42.3
1917........	11.3	10.8	22.1	18.5	15.9	2.2	40.6
1918........	13.6	10.5	24.1	17.0	13.8	3.1	41.1
1919........	11.9	11.6	23.5	18.8	15.4	3.3	42.3
1920........	13.3	6.7	20.0	17.9	14.9	3.5	37.9
1921........	11.2	7.0	18.2	18.2	16.1	2.6	36.4
1922........	14.1	6.7	20.8	18.7	16.9	1.7	39.5
1923........	15.2	6.5	21.7	19.9	17.9	1.8	41.6
1924........	15.4	7.1	22.5	20.3	18.3	2.1	42.8

* Our computations from consumption data and population estimates derived as follows: *Lard* consumption computed from production and export data in Table IX. *Compound* consumption computed from production data in Table X and exports and shipments data by calendar years from Tables V and V *A* and sources there cited. *Butter* consumption, 1900–11, computed from production estimates given in *Farm Economics* (Cornell University), February 1934, p. 2030; 1912–33, from U.S. Department of Agriculture, *Fats and Oils Statistics* . . . . (March 1, 1934), Table 40; and import, export, and shipments data in part from these sources and from *Commerce and Navigation of the United States* and *Monthly Summary of Foreign Commerce of the United States* (using July–June data from 1899–1900 to 1915–16). *Margarine* consumption (for fiscal years ending June 30) computed from production and trade data in Snodgrass, *op. cit.*, 312–13, and for 1929–32 from sources therein cited.

Population estimates here used are as of July 1 (for margarine, January 1), as reported for 1900–08 and 1930–32 in *Statistical Abstract of the United States*, 1933, p. 10, and for 1909–29 as estimated by the National Bureau of Economic Research, as reported for 1909–21 in W. I. King, *The National Income and Its Purchasing Power* (1930), 47, and for 1922–29 in F. C. Mills, *Economic Tendencies in the United States* (1932), 417.

The resulting per capita figures accordingly differ slightly from those given for lard in Table IX and for butter and margarine in Snodgrass, *op. cit.*, 310–11.

[a] Including for margarine successive two-year averages of data in the sixth column.

[b] For *fiscal years* ending June 30, 1900–32.

[c] We regard the 1912 estimate for compound as much too low (see text, p. 107), and consequently also the totals in which it is indicated.

TABLE XX (*Continued*)

Year	Lard	Compound	Lard and compound	Butter and margarine[a]	Butter	Margarine[b]	Four fats[a]
1925........	13.0	9.5	22.5	19.4	17.4	1.9	41.9
1926........	13.5	9.5	23.0	19.3	17.2	2.1	42.3
1927........	13.7	9.7	23.4	19.7	17.4	2.2	43.1
1928........	14.9	9.4	24.3	19.7	17.1	2.5	44.0
1929........	14.2	9.9	24.1	20.5	17.7	2.7	44.6
1930........	13.6	9.7	23.3	19.7	17.2	2.8	43.0
1931........	14.4	9.4	23.8	19.7	17.7	2.2	43.0
1932........	14.6	7.5	22.1	19.8	18.1	1.7	41.9
1933........	15.1	7.4	22.5	20.0	18.3	1.7	42.5

TABLE XXI.—WHOLESALE PRICES OF LARD, NEW YORK, MONTHLY, 1875–1933*

(*Cents per pound*)

Year	Av.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1875..	14.0	14.0	14.0	14.0	15.7	15.4	13.8	13.7	13.7	13.6	14.0	12.9	13.0
1876..	11.8	12.8	13.1	13.9	13.8	12.5	11.5	11.3	10.8	10.6	10.4	10.5	10.6
1877..	9.5	11.3	10.8	9.8	10.1	9.8	9.2	9.3	8.9	9.1	9.0	8.5	8.3
1878..	7.1	7.8	7.7	7.4	7.3	7.0	7.1	7.3	7.7	7.0	6.6	6.2	5.9
1879..	6.6	6.2	6.9	6.6	6.4	6.3	6.4	6.1	5.9	6.2	6.7	7.2	7.9
1880..	7.9	7.9	7.7	7.6	7.4	7.2	7.2	7.3	8.0	8.3	8.6	8.6	8.9
1881..	11.3	9.4	10.3	10.8	11.5	11.2	11.2	12.2	11.6	12.3	12.0	11.4	11.2
1882..	11.8	11.3	11.1	10.8	11.4	11.6	11.8	12.8	12.6	12.4	12.8	11.9	11.0
1883..	9.8	10.8	11.3	11.4	11.4	11.6	10.6	9.1	8.7	8.4	7.9	8.0	8.9
1884..	8.3	9.2	9.9	9.6	8.8	8.5	8.0	7.5	7.9	7.7	7.7	7.4	7.1
1885..	6.8	7.2	7.3	7.2	7.2	7.0	6.8	6.8	6.6	6.4	6.3	6.5	6.4
1886..	6.5	6.4	6.4	6.3	6.2	6.2	6.3	6.8	7.3	7.2	6.1	6.2	6.5
1887.	7.1	6.8	7.1	7.6	7.5	7.0	6.8	6.9	6.8	6.8	6.8	7.2	7.9
1888..	8.7	7.8	8.0	8.0	8.1	8.7	8.7	8.6	9.3	10.6	9.7	8.7	8.5
1889..	6.9	7.6	7.2	7.3	7.2	7.2	6.9	6.6	6.6	6.4	6.8	6.5	6.2
1890..	6.3	6.2	6.2	6.4	6.6	6.5	6.1	6.1	6.4	6.4	6.5	6.3	6.1
1891..	6.6	6.2	6.0	6.5	7.0	6.7	6.4	6.6	6.9	7.2	6.7	6.5	6.4
1892..	7.7	6.6	6.8	6.6	6.5	6.6	6.8	7.5	8.1	7.8	8.8	9.9	10.3
1893..	10.4	11.3	12.7	12.4	10.3	11.1	10.1	10.0	8.5	9.6	10.3	9.4	8.6
1894..	7.7	8.3	7.9	7.3	7.9	7.6	7.0	7.3	7.9	9.1	7.8	7.4	7.2

* The standard grade quoted is variously termed "Western Steam" or "Prime Contract." Data from *Annual Statistical Reports of the New York Produce Exchange, 1907*, p. 110; *ibid., 1929*, p. 108; and for 1930–33 direct from the New York Produce Exchange. Data are monthly averages of daily quotations as reported, except for 1879–88, which are our computations of means of monthly highs and lows reported. Annual averages are simple averages of monthly data.

TABLE XXI (*Continued*)

(*Cents per pound*)

Year	Av.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1895..	6.5	7.0	6.8	7.0	7.2	6.9	6.7	6.4	6.4	6.2	6.0	5.8	5.5
1896..	4.7	5.9	5.8	5.5	5.2	4.8	4.4	3.8	3.7	3.8	4.6	4.4	4.1
1897..	4.4	4.2	4.1	4.4	4.4	4.1	3.9	4.3	4.8	5.0	4.7	4.5	4.7
1898..	5.5	5.1	5.3	5.4	5.6	6.5	6.1	5.8	5.5	5.2	5.2	5.2	5.4
1899..	5.6	5.9	5.7	5.6	5.5	5.3	5.3	5.6	5.6	5.7	5.7	5.4	5.7
1900..	7.0	6.2	6.3	6.4	7.4	7.3	7.0	7.1	7.1	7.3	7.5	7.5	7.4
1901..	8.9	7.6	7.8	8.1	8.7	8.4	8.8	8.9	9.1	10.1	9.8	9.1	10.2
1902..	10.6	9.9	9.7	9.8	10.1	10.6	10.7	11.2	10.9	11.0	11.1	11.2	10.9
1903..	8.8	10.3	10.3	10.3	10.2	9.3	9.0	8.0	8.0	8.8	7.3	7.3	7.0
1904..	7.3	7.4	7.9	7.3	7.0	6.8	7.0	7.2	7.2	7.5	7.9	7.4	7.2
1905..	7.4	7.0	7.0	7.2	7.4	7.3	7.2	7.3	8.0	7.9	7.6	7.5	7.9
1906..	8.9	7.9	8.0	8.3	8.9	8.8	9.0	9.1	9.0	9.0	9.6	9.6	9.2
1907..	9.2	9.7	10.1	9.4	9.0	9.3	9.0	9.1	9.2	9.2	9.3	8.6	8.4
1908..	9.1	8.2	7.5	8.0	8.5	8.6	8.9	9.6	9.7	10.5	10.1	9.7	9.6
1909..	11.7	9.9	9.8	10.4	10.6	11.0	11.9	12.0	12.0	12.7	12.7	13.5	13.5
1910..	12.5	12.7	12.9	14.4	13.4	13.2	12.5	12.0	12.0	12.7	12.7	11.2	10.6
1911..	9.1	10.6	9.7	9.2	8.2	8.3	8.5	8.4	9.2	9.6	9.1	9.3	9.2
1912..	10.5	9.3	9.0	9.4	10.4	10.7	10.7	10.5	11.0	11.4	11.8	11.3	10.6
1913..	11.0	10.1	10.6	11.1	11.2	11.1	11.1	11.6	11.4	11.4	10.8	11.0	10.8
1914..	10.4	11.0	10.7	10.6	10.4	10.1	10.1	10.2	10.0	10.0	10.4	11.1	10.3
1915..	9.4	10.7	10.3	9.9	9.9	9.8	9.2	8.2	8.1	8.3	9.4	9.3	9.8
1916..	13.5	10.4	10.3	11.2	12.2	13.1	13.1	13.2	13.8	14.9	15.8	17.3	16.6
1917..	21.9	16.1	17.0	19.9	21.6	22.6	21.2	20.1	22.7	24.4	24.6	27.6	25.3
1918..	26.0	25.1	26.5	26.6	25.8	25.1	24.5	26.2	26.8	27.1	26.3	27.0	25.5
1919..	28.9	23.8	25.0	27.8	30.9	34.0	34.9	35.0	30.7	26.7	28.2	26.2	23.7
1920..	19.9	24.0	20.9	20.3	20.0	20.8	20.4	19.3	19.0	20.2	20.6	19.2	14.6
1921..	11.1	13.6	12.4	12.2	10.5	9.9	10.2	12.3	11.8	11.3	10.1	9.8	9.4
1922..	11.5	10.0	11.7	11.7	11.2	12.0	12.0	11.7	11.4	11.4	11.7	11.5	11.4
1923..	12.3	11.8	11.7	12.5	11.9	11.6	11.4	11.3	11.6	12.8	13.3	14.3	12.9
1924..	13.1	12.8	11.6	11.5	11.3	11.0	11.1	12.8	14.4	14.3	14.4	15.3	16.9
1925..	16.7	16.5	16.0	17.2	16.1	16.3	17.6	18.1	17.9	17.8	16.3	16.2	14.9
1926..	15.0	15.7	15.2	15.1	14.6	15.9	17.0	16.4	15.6	15.1	14.3	12.8	12.9
1927..	12.8	12.9	12.8	13.0	12.8	12.9	13.1	13.0	12.7	13.2	12.9	12.6	12.1
1928..	12.3	12.4	11.6	11.8	12.1	12.3	12.1	12.6	12.9	13.2	12.4	12.0	11.7
1929..	12.0	12.2	12.3	12.5	12.2	12.1	12.3	12.6	12.4	12.1	11.4	11.0	10.8
1930..	10.9	10.8	11.2	10.7	10.8	10.7	10.2	10.0	11.4	12.0	12.0	11.1	10.0
1931..	8.0	9.0	8.5	9.3	9.0	8.2	8.3	8.1	7.5	7.5	8.0	7.0	6.0
1932..	5.0	5.5	5.2	5.1	4.8	4.3	4.3	5.5	5.5	5.4	4.8	5.3	4.7
1933..	5.6	4.7	4.3	4.6	5.2	6.5	6.6	6.9	6.0	6.1	5.6	5.8	5.1

TABLE XXII.—WHOLESALE PRICES OF COTTONSEED OIL (PRIME SUMMER YELLOW), NEW YORK, MONTHLY, 1875–1933*

(*Cents per pound*)

Year	Av.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1875..	7.6	7.0	7.0	6.9	8.0	9.2	8.3	7.6	7.2	7.2	7.4	7.9	7.7
1876..	6.8	7.9	7.8	7.4	7.2	6.7	6.5	6.4	6.3	6.2	6.2	6.4	6.6
1877..	7.0	7.0	7.2	6.7	6.8	6.8	6.7	6.9	7.1	7.1	7.2	7.3	7.3
1878..	6.3	6.8	6.8	6.6	6.3	6.6	6.4	6.3	6.3	6.0	6.0	5.9	5.5
1879..	5.8	5.4	5.5	5.4	5.4	5.6	5.8	5.8	5.7	5.6	6.0	6.3	6.6
1880..	5.7	6.9	6.4	6.0	5.5	5.4	5.5	5.3	5.3	5.5	5.6	5.6	5.7
1881..	6.2	5.6	5.7	6.0	5.9	6.0	5.9	5.8	6.0	6.9	7.8	6.8	6.6
1882..	7.1	6.3	6.0	6.1	6.6	7.1	7.1	7.6	8.0[a]	8.1	8.1	7.3	6.7
1883..	6.2	6.3	6.5	6.8	6.6	6.5	6.4	6.2	6.1[a]	5.8	5.7	5.6	5.9
1884..	5.6	6.0	5.9	5.8	5.6	5.6	5.5	5.4	5.5[a]	5.7	5.7	5.4	5.4
1885..	5.1	5.3	5.4	5.3	5.2	5.1	5.1	5.0	5.0	5.0	5.0	4.8	4.5
1886..	4.6	4.2	4.2	3.9	3.9	3.9	4.3	4.6	5.1	5.3	5.1	5.1	5.1
1887..	5.4	5.4	5.3	5.2	5.0	5.2	5.5	5.4	5.3	5.4	5.5	5.9	5.7
1888..	6.1	5.5	5.5	5.4	5.2	6.0	6.2	6.2	6.3	6.4	6.8	7.0	7.2
1889..	6.3	7.1	6.6	6.7	6.8	6.7	6.7	6.7	6.7	6.1	5.9	5.0	4.6
1890..	4.7	4.5	4.6	4.6	4.8	5.0	5.0	4.8	4.7	4.6	4.5	4.5	4.5
1891..	4.9	4.7	4.6	4.8	5.1	5.4	5.5	5.5	5.3	5.2	4.6	3.9	4.0
1892..	4.2	3.9	3.9	3.8	4.2	4.2	4.3	4.3	4.2	4.1	4.1	4.4	5.5
1893..	6.0	6.6	8.2	7.5	6.2	6.5	5.8	5.7	5.6	5.1	5.3	5.0	4.5
1894..	4.3	4.7	4.5	4.2	4.4	4.4	4.4	4.4	4.4	4.6	4.2	4.0	3.8
1895..	3.6	3.7	3.5	3.5	3.6	3.6	3.6	3.6	3.7	3.6	3.7	3.9	3.8
1896..	3.4	3.8	3.5	3.4	3.4	3.3	3.3	3.2	3.1	3.2	3.6	3.4	3.1
1897..	3.2	3.1	3.1	3.1	3.1	3.2	3.1	3.3	3.5	3.6	3.2	2.9	2.9
1898..	3.1	3.0	3.0	3.0	3.0	3.4	3.3	3.1	3.1	3.0	3.0	3.0	2.9
1899..	3.5	3.1	3.3	3.5	3.5	3.4	3.4	3.4	3.5	3.5	3.9	3.7	4.3
1900..	4.7	4.8	5.0	4.8	5.0	5.0	4.8	4.9	4.6	4.8	4.8	4.4	4.0
1901..	4.8	4.1	4.1	4.2	4.7	4.6	5.0	5.1	5.3	5.5	5.5	4.7	5.3
1902..	5.5	5.7	5.5	5.6	5.8	6.1	6.0	5.8	5.6	5.4	5.1	4.7	5.0
1903..	5.4	5.4	5.4	5.5	5.7	5.7	5.6	5.7	5.5	5.5	5.3	4.6	4.8
1904..	4.1	4.9	5.1	4.9	4.3	3.8	3.9	3.5	3.8	3.9	3.8	3.6	3.3
1905..	3.6	3.1	3.5	3.4	3.4	3.7	3.8	3.8	4.0	3.6	3.5	3.8	4.0
1906..	5.0	4.4	4.2	4.4	4.9	5.2	4.9	5.1	5.0	5.1	5.7	5.3	5.6
1907..	6.5	6.0	6.3	6.3	6.1	7.3	7.8	7.5	7.3	7.4	6.5	4.6	5.0
1908..	5.6	6.1	5.5	5.3	5.7	6.1	6.3	6.1	5.1	5.3	5.1	5.1	5.2
1909..	5.9	5.5	5.5	5.4	5.6	5.7	5.7	5.6	5.5	5.9	6.6	6.8	7.3

* For 1875–90, basic data from *Oil, Paint, and Drug Reporter.* Average of prices as of the first and fifteenth of the month and the prices as of the first of the month following, the mid-month price being weighted doubly, 1875 to July 1885; averages of monthly high and low prices of "Prime Cottonseed Oil for Immediate Shipment from the Southeast," August 1885 to December 1890. For 1891–1932, monthly averages of daily quotations direct from the New York Produce Exchange, 1891–99 and 1930–33, and for 1900–29 from *Annual Statistical Reports of the New York Produce Exchange*, except as noted. These averaged about .2 cent per pound above averages of monthly price ranges as reported in the *Oil, Paint, and Drug Reporter* for 1891 and about .1 cent above for 1930. Annual averages are simple averages of monthly data.

[a] Average of prices as of the first of August and the first of September.

TABLE XXII (*Continued*)

(*Cents per pound*)

Year	Av.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1910..	8.1	7.3	7.1	7.5	7.8	8.0	8.0	8.5	10.8	10.1	8.1	7.3	7.2
1911..	6.3	7.3	7.0	6.6	6.2	6.6	6.4	5.9	5.8	7.0	6.0	5.7	5.4
1912..	6.3	5.4	5.5	5.7	6.5	7.2	6.9	6.7	6.5	6.4	6.2	6.0	6.3
1913..	7.3	6.2	6.4	6.4	7.0	7.0	7.7	9.1	8.9	7.7	7.0	7.0	6.9
1914..	6.7	7.0	7.1	7.4	7.5	7.2	7.3	7.2	6.7	5.9	5.2	5.6	5.8
1915..	6.8	6.6	7.1	6.7	6.6	6.4	6.2	6.1	5.8	6.3	7.7	7.9	8.4
1916..	10.6	8.6	9.6	10.5	10.7	10.9	10.9	10.0	9.3	10.2	11.8	12.5	12.4
1917..	15.6	12.3	12.5	13.6	15.3	16.2	16.3	14.5	14.8	16.4	18.0	18.6	18.6
1918..	20.1	20.1	20.3	19.8	19.8	19.9[b]	20.2[b]	20.2[b]	20.2[b]	20.2[b]	20.2[b]	20.2[b]	20.2[b]
1919..	22.4	20.2[b]	20.2[b]	20.2[b]	21.2[b]	21.2[b]	25.0	27.4	25.9	21.3	23.5[c]	22.0[c]	20.8[c]
1920..	15.4	21.9	19.7	19.1	18.5	19.2	16.7	13.2	12.3	13.5	11.4	10.1	8.9
1921..	8.0	8.6	7.3	6.3	6.2	7.2	7.5	8.6	8.7	9.9	8.7	8.3	8.3
1922..	10.2	8.6	9.9	11.5	11.6	11.7	11.3	10.7	10.0	8.7	8.9	9.5	9.8
1923..	11.3	10.8	10.9	11.8	11.8	11.6	11.4	10.4	10.3	11.6	12.1	11.6	11.0
1924..	10.9	11.0	10.4	9.8	10.1	9.8	10.4	12.1	13.8	10.5	11.0	10.9	11.4
1925..	10.8	11.2	10.7	11.2	11.1	10.6	10.8	11.4	11.2	10.8	9.9	10.3	10.5
1926..	11.9	11.3	11.3	12.3	12.4	14.5	15.4	14.9	13.1	11.2	9.5	8.2	8.2
1927..	9.7	8.5	9.3	9.4	8.8	9.1	9.2	9.6	10.0	10.8	10.8	10.6	10.0
1928..	9.9	10.0	9.3	9.6	10.1	10.6	10.2	10.0	9.5	10.0	9.9	9.7	10.2
1929..	9.7	10.3	10.6	10.7	10.1	9.4	9.4	9.7	9.3	9.2	9.4	9.0	8.8
1930..	8.2	8.5	8.5	8.4	8.8	8.8	8.5	8.0	8.3	8.2	7.6	7.6	7.3
1931..	6.1	7.2	7.3	7.6	7.4	6.9	6.7	7.0	5.4	4.2	4.4	4.5	4.1
1932..	3.8	4.1[d]	4.1[d]	4.0[d]	3.4[d]	3.2[d]	3.2[d]	3.8[d]	4.5[d]	4.5[d]	4.0[d]	3.7[d]	3.5[d]
1933..	4.4	3.6[d]	3.5[d]	3.7[d]	4.2[d]	5.0[d]	5.6[d]	6.1[d]	5.3[d]	4.8[d]	4.2[d]	3.7[de]	3.4[de]

[b] Monthly average of high and low prices as reported in *Oil, Paint, and Drug Reporter*, here compiled from *Statistics of Fats, Oils, and Oleaginous Raw Materials* (U.S. Department of Agriculture Statistical Bulletin No. 24, September 1928), 58. Corresponding prices for June to September 1919 run considerably lower than the ones here included.

[c] Averages of monthly high and low prices as reported in *Annual Statistical Report of the New York Produce Exchange, 1919*, p. 93. Prices were not reported continuously during these months.

[d] Prices of "Bleachable Prime Summer Yellow" cottonseed oil, which averaged about .1 cent above prices of "Prime Summer Yellow" from April 1931 to March 1932.

[e] Computed from prices of near futures, no "spot" quotations being reported.

Table XXIII.—Wholesale Prices of Compound, New York, Monthly, 1897–1933*

(Cents per pound)

Year	Av.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1897..	4.3	...	4.2	4.2	4.3	4.1	3.9	4.1	4.4	4.9	4.6	4.2	4.1
1898..	4.3	4.2	4.4	4.2	4.1	4.6	4.8	4.4	4.4	4.4	4.1	3.9	4.1
1899..	4.9	4.4	4.4	4.6	4.6	4.6	4.7	4.7	5.4	5.1	5.3	5.4	5.3
1900..	6.2	5.8	6.2	6.2	6.4	6.4	6.3	6.3	6.1	6.1	6.2	6.1	5.9
1901..	6.9	5.8	5.6	5.8	6.4	6.6	6.9	7.0	7.2	7.8	8.0	7.6	7.9
1902..	8.0	8.1	8.0	7.5	8.2	8.6	8.4	8.2	8.1	7.6	7.6	7.6	7.6
1903..	7.2	7.6	7.6	7.6	7.4	7.6	7.5	7.4	7.0	7.1	7.1	6.5	6.2
1904..	6.1	6.6	6.8	6.9	6.5	5.9	5.8	5.8	5.9	5.7	6.1	5.7	5.3
1905..	5.3	4.8	4.8	4.8	5.1	5.3	5.3	5.5	5.8	5.8	5.6	5.5	5.6
1906..	6.9	5.8	6.1	6.0	6.6	7.1	7.0	7.1	7.1	7.1	7.4	7.8	7.8
1907..	8.5	8.2	8.5	8.4	8.1	8.2	9.1	9.1	8.9	8.8	8.8	8.1	7.4
1908..	7.5	7.2	7.1	6.9	7.5	7.8	7.9	8.1	8.2	7.9	7.7	7.2	7.1
1909..	8.4	7.2	7.6	7.9	8.0	7.9	8.2	7.8	7.7	8.1	9.5	10.2	10.2
1910..	10.0	10.2	9.8	10.1	10.4	10.1	9.5	9.6	10.8	11.2	10.4	9.0	8.8
1911..	7.6	8.8	8.2	7.9	7.2	7.2	7.5	7.5	7.4	7.6	7.9	7.5	7.1
1912..	8.1	6.8	7.0	7.2	8.3	9.0	8.9	8.7	8.4	8.2	8.2	8.1	7.9
1913..	8.7	7.8	7.8	7.9	8.3	8.4	8.8	9.8	10.4	9.8	8.7	8.6	8.6
1914..	8.1	8.3	8.3	8.2	8.4	8.2	8.4	8.5	8.4	8.2	7.4	7.2	7.4
1915..	7.9	7.4	7.6	7.8	7.6	7.5	7.3	7.1	7.0	7.2	8.9	9.6	9.7
1916..	12.1	10.1	10.5	11.2	12.0	12.0	12.0	11.4	10.8	11.5	13.6	15.0	14.6
1917..	17.3	14.2	12.0	14.4	16.4	18.0	18.2	16.8	16.2	17.0	20.1	21.4	22.8
1918..	23.1	23.0	23.0	23.0	23.0	22.2	23.1	22.9	23.1	23.1	23.6	23.6	23.6
1919..	25.2	23.6	23.6	23.6	23.1	24.1	26.9	29.2	28.5	26.8	23.5	25.4	24.6
1920..	19.4	25.0	24.0	22.4	22.0	21.5	21.0	19.1	18.0	16.8	16.2	14.2	12.1
1921..	10.3	11.4	10.6	9.8	8.5	8.8	9.2	10.2	11.0	11.6	11.8	10.5	10.1
1922..	12.0	10.2	11.6	13.5	13.0	13.0	13.0	12.5	11.8	11.1	11.0	11.1	11.8
1923..	12.9	12.4	12.8	13.2	13.5	13.2	12.8	12.2	11.9	12.9	13.4	13.6	13.4
1924..	13.0	13.1	12.1	11.9	11.9	11.8	12.0	13.8	15.8	14.0	13.0	13.0	13.4
1925..	13.0	13.8	13.2	13.2	13.5	12.8	12.5	13.2	14.0	12.9	12.6	12.4	12.5
1926..	13.8	12.8	13.2	13.8	14.1	15.4	17.0	16.8	15.2	14.1	12.2	10.5	10.1
1927..	11.8	10.0	10.8	11.2	11.0	11.1	11.2	11.5	12.0	13.2	13.8	13.2	12.9
1928..	12.0	12.6	11.9	11.4	12.0	12.5	12.2	12.1	11.8	11.8	11.9	11.8	12.0
1929..	11.5	12.0	12.2	12.5	12.1	11.5	11.1	11.2	11.0	11.2	11.1	10.8	10.8
1930..	10.5	10.6	10.6	10.8	10.8	10.8	10.5	10.5	10.5	10.5	10.2	10.2	10.1
1931..	8.9	9.9	9.8	9.9	10.2	9.4	9.2	9.5	9.1	8.5	7.5	7.5	6.8
1932..	6.2	6.5	6.2	6.1	5.9	5.6	5.6	5.9	6.9	6.9	6.5	6.2	6.1
1933..	7.0	6.0	5.8	6.7	6.2	7.4	7.6	7.8	8.1	7.6	7.2	7.1	7.0

* Averages of monthly high and low prices as reported in the *Oil, Paint, and Drug Reporter:* our computations for all years except 1918 to 1925, for which data are from *Statistics of Fats, Oils, and Oleaginous Raw Materials* (U.S. Department of Agriculture Statistical Bulletin No. 24, September 1928), 62. Annual averages are simple averages of monthly data.

TABLE XXIV.—WHOLESALE PRICES OF OLEOSTEARIN, NEW YORK, MONTHLY, 1892–1933*

(Cents per pound)

Year	Av.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1892..	8.5	7.1	7.4	7.1	7.2	7.1	7.2	8.1	9.1	9.9	9.9	10.5	10.9
1893..	9.4	10.7	12.2	9.2	7.1	8.7	8.5	8.5	9.2	11.4	11.1	9.3	7.1
1894..	7.7	7.9	7.4	6.9	7.6	7.4	7.7	7.5	8.1	10.1	7.8	7.1	7.4
1895..	6.8	6.8	6.6	8.2	8.8	8.1	7.4	6.8	6.1	6.0	6.0	5.6	5.1
1896..	4.6	5.0	4.9	4.7	4.5	4.3	4.4	4.3	4.1	4.2	5.1	5.0	4.2
1897..	4.6	4.3	4.1	4.3	4.3	4.1	4.2	4.6	5.1	5.9	5.1	4.6	4.5
1898..	5.0	4.8	4.8	4.7	4.6	5.9	5.3	5.0	5.1	5.0	5.1	5.2	5.1
1899..	6.4	5.1	5.7	5.7	5.8	5.7	5.8	6.5	7.1	7.2	8.1	7.2	7.1
1900..	7.1	7.2	6.8	6.5	7.6	7.1	6.4	7.6	7.4	7.4	7.4	6.8	6.6
1901..	9.3	7.1	7.2	7.4	8.8	8.8	9.3	9.6	9.6	10.9	11.6	10.4	10.5
1902..	12.5	11.1	9.9	9.3	11.5	13.4	13.1	13.4	13.6	13.7	14.8	14.2	11.6
1903..	8.3	10.4	10.2	9.9	9.5	8.5	7.9	7.6	7.2	7.9	7.6	6.4	6.1
1904..	6.7	6.6	6.8	6.9	6.1	5.7	6.0	6.9	7.1	7.6	8.1	6.7	6.4
1905..	7.6	6.4	6.4	7.2	8.2	7.9	7.5	7.5	8.6	8.6	7.2	7.4	7.8
1906..	9.4	7.7	7.8	7.8	9.6	9.6	9.0	8.9	10.0	9.8	9.6	11.5	11.6
1907..	9.5	11.8	11.2	10.0	9.1	9.4	9.6	8.9	8.6	8.6	9.6	8.9	7.8
1908..	10.4	7.6	7.2	7.5	10.8	11.0	10.9	11.6	12.1	13.0	12.5	10.5	10.1
1909..	13.8	11.8	13.0	13.2	12.9	12.5	13.1	13.0	11.6	13.6	17.4	16.5	17.4
1910..	13.2	17.2	14.8	16.9	17.2	15.0	12.0	10.0	11.8	11.5	12.5	10.6	9.5
1911..	8.7	9.2	8.2	7.6	7.2	7.8	8.0	7.6	8.9	11.5	10.2	9.6	9.2
1912..	12.2	9.1	8.9	9.0	12.9	15.5	14.2	12.5	12.8	13.6	14.0	12.8	11.0
1913..	9.9	9.9	10.0	10.5	11.0	10.0	8.8	10.5	10.5	9.2	8.8	9.9	10.0
1914..	9.2	9.1	9.2	8.9	8.8	8.6	8.1	7.9	9.4	10.5	9.0	10.2	10.9
1915..	9.6	10.1	10.2	9.1	9.1	9.1	8.8	8.2	9.5	10.0	10.6	10.5	10.1
1916..	12.0	9.8	10.0	10.6	11.8	12.1	11.0	10.6	10.4	12.6	14.5	15.4	15.2
1917..	18.1	13.2	13.1	14.6	17.5	20.6	18.9	17.1	18.5	20.2	22.6	21.4	19.6
1918..	20.6	18.4	19.9	20.5	19.4	18.4	18.5	19.6	21.0	21.8	24.2	24.1	21.2
1919..	22.2	16.1	12.9	14.4	26.6	33.0	28.8	28.8	25.0	18.5	20.2	21.2	20.9
1920..	15.0	21.9	19.5	17.4	16.5	15.1	14.5	12.9	13.4	14.5	15.0	10.5	8.5
1921..	8.5	8.2	7.8	7.0	6.8	7.8	7.5	9.5	10.8	10.8	9.8	7.8	7.8
1922..	9.6	8.1	9.8	10.0	8.8	9.0	10.0	10.1	9.8	9.2	10.0	10.9	9.9
1923..	10.5	10.2	10.4	10.8	10.8	9.8	8.4	9.0	10.4	12.9	12.0	11.0	10.5
1924..	11.4	10.0	9.8	9.2	10.2	10.5	10.1	12.9	16.1	11.9	12.5	12.0	11.5
1925..	13.0	11.0	10.5	13.4	12.5	11.5	12.8	13.8	14.8	14.1	14.8	13.9	13.1
1926..	11.9	12.4	11.5	12.5	11.2	13.0	14.6	13.2	11.4	12.8	11.2	9.9	9.6
1927..	10.3	9.4	9.9	9.5	9.1	9.6	9.6	9.9	10.6	12.5	12.4	10.8	9.9
1928..	10.6	10.0	9.5	10.2	11.4	10.9	9.6	10.1	10.8	12.4	11.2	10.6	10.5
1929..	10.5	11.1	11.6	11.1	10.8	9.9	9.8	10.0	10.8	10.9	10.5	9.9	9.6
1930..	8.7	9.2	9.2	8.9	8.9	8.6	8.4	8.1	8.6	9.4	8.5	8.4	8.8
1931..	7.3	7.6	7.4	8.1	8.1	7.1	6.8	7.9	8.2	7.5	6.6	6.5	6.0
1932..	4.8	5.0	4.4	4.1	4.0	3.9	4.0	5.0	6.2	6.4	5.6	4.6	4.1
1933..	4.9	3.9	3.8	3.9	4.3	5.1	5.1	5.8	6.0	5.1	5.2	5.4	5.3

* Data are monthly averages of daily prices direct from the New York Produce Exchange, 1892–99 and 1930–33, and for 1900–29 from *Annual Statistical Reports of the New York Produce Exchange.* Annual averages are simple averages of monthly data.

TABLE XXV.—EXCESS OF LARD PRICES OVER PRICES OF COTTONSEED OIL AND COMPOUND, ANNUAL AVERAGES, 1875–1933*

(Cents per pound)

Year	Cottonseed oil	Year	Cottonseed oil	Compound	Year	Cottonseed oil	Compound
1875......	6.4	1895.....	2.9	...	1915.....	2.6	1.5
1876......	5.0	1896.....	1.3	...	1916.....	2.9	1.4
1877......	2.5	1897.....	1.2	0.1	1917.....	6.3	4.6
1878......	0.8	1898.....	2.4	1.2	1918.....	5.9	2.9
1879......	0.8	1899.....	2.1	0.7	1919.....	6.5	3.7
1880......	2.2	1900.....	2.3	0.8	1920.....	4.5	0.5
1881......	5.1	1901.....	4.1	2.0	1921.....	3.1	0.8
1882......	4.7	1902.....	5.1	2.6	1922.....	1.3	—0.5
1883......	3.6	1903.....	3.4	1.6	1923.....	1.0	—0.6
1884......	2.7	1904.....	3.2	1.2	1924.....	2.2	0.1
1885......	1.7	1905.....	3.8	2.1	1925.....	5.9	3.7
1886......	1.9	1906.....	3.9	2.0	1926.....	3.1	1.2
1887......	1.7	1907.....	2.7	0.7	1927.....	3.1	1.0
1888......	2.6	1908.....	3.5	1.6	1928.....	2.4	0.3
1889......	0.6	1909.....	5.8	3.3	1929.....	2.3	0.5
1890......	1.6	1910.....	4.4	2.5	1930.....	2.7	0.4
1891......	1.7	1911.....	2.8	1.5	1931.....	1.9	—0.9
1892......	3.5	1912.....	4.2	2.4	1932.....	1.2	—1.2
1893......	4.4	1913.....	3.7	2.3	1933.....	1.2	—1.4
1894......	3.4	1914.....	3.7	2.3			

* Computed from data in Tables XXI–XXIII.

TABLE XXVI.—PRICES OF COTTONSEED OIL AND OF COMPOUND, EXPRESSED AS PERCENTAGES OF LARD PRICES, ANNUAL AVERAGES, 1875–1933*

Year	Cottonseed oil	Year	Cottonseed oil	Compound	Year	Cottonseed oil	Compound
1875......	54	1895.....	55	..	1915.....	72	84
1876......	58	1896.....	72	..	1916.....	79	90
1877......	74	1897.....	73	98	1917.....	71	79
1878......	89	1898.....	56	78	1918.....	77	89
1879......	88	1899.....	62	88	1919.....	78	87
1880......	72	1900.....	67	89	1920.....	77	97
1881......	55	1901.....	54	78	1921.....	72	93
1882......	60	1902.....	52	75	1922.....	89	104
1883......	63	1903.....	61	82	1923.....	92	105
1884......	67	1904.....	56	84	1924.....	83	99
1885......	75	1905.....	49	72	1925.....	65	78
1886......	71	1906.....	56	78	1926.....	79	92
1887......	76	1907.....	71	92	1927.....	76	92
1888......	70	1908.....	62	82	1928.....	80	98
1889......	91	1909.....	50	72	1929.....	81	96
1890......	75	1910.....	65	80	1930.....	75	96
1891......	74	1911.....	69	84	1931.....	76	111
1892......	55	1912.....	60	77	1932.....	76	124
1893......	58	1913.....	66	79	1933.....	79	125
1894......	56	1914.....	64	78			

* Computed from data in Tables XXI–XXIII.

INDEX

Adulteration:
- of butter, 35
- of foods, 34–37
- of lard, 8–9, 18, 20–22, 23, 31, 60, 64, 115; Congressional action on, 22, 23, 48–54; early legislative action on, 40–45; McGeogh Case, 37–40; "original package" decision, 41; regional aspects of, 36–37, 48–50, 56–58; reports of Division of Chemistry on, 47–48; state and federal investigations on, 47–48
- of olive oil, 15, 20, 28
- of tallows, 21

Advertising of compound, 185, 193, 196–97, 207

Agricultural Adjustment Act, 133–34, 145, 177, 217, 221–22

Agricultural Yearbook, 1903, 79

American Cotton Oil Company, 30, 80, 81, 83, 94, 113, 149, 154, 177, 259, 266; *see* Appendix D

American Cotton Oil Trust, 24, 30, 80

Anglo-American Packing and Provision Company, 38; *see* Appendix D

Annual Report (United States Food Administration) *for 1918, The,* 111

Armour and Company, 22–23, 32, 43, 46, 60, 72, 83, 88, 149, 150; *see* Appendix D

Armstrong Packing Company, 74; *see* Appendix D

Aspegren and Company, estimates of, cottonseed oil: in compound manufacture, 69–71; in compound manufacture, in Europe, 103 n.; consumption, 31–32, 77; production, 63–64; *see* Appendix D

Baker, Representative, 42

Baking, commercial, expansion of, 195; use of shortening by industry, 191–92

Belgium, as importer of compound, 108

Biennial Census of Manufactures, 138

"Bird," 74

Bleaching oil, 20–21, 253–58

Bradley, Henry W., 25

Bread, during the war, 111; use of shortening in, 6

Brosius, Representative, 53, 56–57

Brown, Dr. Campbell, 46

Brown, Robert B., 74; *see* Appendix D

Brown Company, 122, 267

Butchers' National Protective Association, 41

Butchers' Sons, Washington, 28; *see* Appendix D

Butter: adulteration of, 35; consumption of, in Germany, 158; cost of production, 148; as a shortening, 5, 6, 281, 282; in national economy of Denmark, 213–14

Butterworth bills, on lard adulteration, 41, 42, 48

Central America, as importer of compound, 101; as importer of lard, 102
Charlotte Observer, 65
Chemistry, early use of, in England, to detect adulteration of lard, 46; in development of compound industry, 20, 87; *see* Hydrogenation
Chicago Board of Trade, hedging in lard futures on, 183; reports of, on lard adulteration, 37–39, 42–43
Chinese [tung] oil, 163
Cincinnati Chamber of Commerce, 41
Cincinnati Pork Packers Association, 41
Cincinnati Price Current, 32
Cochran, Samuel H., 26, 27; *see* Appendix D
Coconut oil: early use of, in Europe, 8; first industrial use of, 248; use of, in compound, 125, 126, 127–28, 129, 145, 157; use of, in margarine, 127–28, 129; use of, in soap industry, 127, 129
Coconut stearin, early use of, in Europe, 8
Conger bill, 42, 48, 51, 53
Consumption:
of cottonseed oil, 14, 17, 64, 67, 166
of lard and compound, 32–33, 126–27, 171, 176, 191, 195–96; by bakeries, 191; coefficient of correlation between, 179–80; expansion of, difficulties in, 217; in Germany, 157–59; long-time trend upward, 3; seasonal variation in, 183
of tallow in Germany, 158
See Consumption, per capita
Consumption, per-capita:
of butter, 186, 188, 189, 192
of compound, 186, 188–89, 191; comparison of lard and, 187–89; increase in, 3
of fruits and vegetables, 190–91
of lard, 105, 112, 170, 185–86, 191, 205; comparison of compound and, 187–89; increase in, 3
of lard substitutes, 187–88
of margarine, 186, 189
of shortenings, 5–6
of vegetable oils and fats only and animal and vegetable oils and fats, 194
See Consumption
Copra, duty-free, 126, 165
Corn (maize) oil, shortening power of, 280; use of, in compound, 125, 132; use of, in mayonnaise, 132
"Cotosuet," 73, 76
"Cottolene," 29, 30, 75, 258; exports of, 97
Cottonseed oil: bleaching of, 20–21, 254–55; in compound, 2, 63–64, 117, 133, 145, 215–16; domestic retention of, early, 14; food uses of, 18, 19, 87–88; in the national economy, 214–16; process for deodorizing, etc., 25–26; shortening power of, 280–81, 283; as a stiffening agent, 21–22; as substitute for olive oil, 28; supply of, factors in, 217–18; United States Food Administration reports and regulations on, 306–09; uses of exported, 31; winterizing (demargarinating), 116
Coumbe, Oscar H., 26
"Crisco," 94

Crosfield patent, 93, 267
Cuba, as importer of compound, 101, 108
Cudahy Packing Company, 73–74, 149; *see* Appendix D

Dawes, Senator, 41, 54
Demand:
  for compound, inelastic, 3, 76, 176, 179; recent independence of compound from lard, 211–12
  for lard, relationship, 2, 3, 176
Denmark, relationship between butter and margarine in national economy of, 213–14
Deodorizing, of compound, 77; of oils, 25–26, 258–59
Duties, *see* Tariffs

Eckstein, H. G., 77; *see* Appendix B
England: as importer of compounds, 98–99; as importer of lard, 101; legal prosecution of lard adulteration in, 23; legal prosecution of misbranding in, 46–47
Exports:
  compound; of Cottolene and Lardine (Lardene), 97; by countries of destination, 98–104, 108–12; in late 'nineties, 67; to 1914, 98, 99; post-war, 112, 113, 114, 115–16, 153–59; reason for recent decline in, 154–55; to United States possessions, 154; during the war, 108–12
  cottonseed oil, 14, 15–16; reason for decline in, 164
  fats and oils, in the United States, 162
  lard; annually, 1908–09 to 1932, 109; by countries of destination, 101–02; during the war, 108–09, 112; early figures on, 33, 67, 98; level of, 1920–29, 160; measures for reducing, 216; from 1900–1932, 171, 175 n.; to 1914, 98–99; post-war, 112, 155, 165; restrictions on, European countries, 40, 43; surplus for, 163; to United States possessions, 154
  oleo oil, 165
  peanut oil, 126
  soy bean oil, 126
  vegetable shortenings, 116, 155

Fairbank, N. K., Company, 9, 20, 21, 22–23, 24, 28, 29, 32, 43, 46, 60, 75, 94, 97, 150, 254, 256, 259, 263, 266; *see* Appendix D
"Flakewhite," 75, 93
Foaming, in compounds, with coconut oil, 128
Food and Drugs Act, 58, 90, 94
Food-control bills, other than on lard adulteration, 54–56
Fowler Brothers, 38, 39; *see* Appendix D
France, as importer of compounds, 100–101, 108

Georgia Mills and Elevator Company, 74; *see* Appendix D
Germany: coconut oil, use of in manufactured compounds, 128; consumption of fats in, 158; consumption of margarine in, 155–56, 158; as importer of animal fats, 158; as

importer of compounds, 98, 100, 103; as importer of lard, 101–2; palm kernel oil, use of, in margarine, 131; as producer of compound, 157–59, 259–60; tariffs on fat in, 159
Grasa, 159

Hately, John, 43, 52
Hawaii, shipments of compound to, 154
Hedging, on lard and cottonseed oil futures, 183
"Hope Butter Oil," 19
Hope Oil Mill, 19
Hydrogenation, 76, 88, 264–74, 282–83; cost of, 122; of cottonseed oil, 116; economic effects of, 92–94, 103; of marine oils, 123; plants specializing in, 122–23; in vegetable shortening, 116, 121–22, 142

Imports, oils, United States, 124, 125, 126, 132, 162–63, 165
Ingredients: in compounds, 2, 66, 85, 114–35, 142, 145; in margarine, 11–12, 21, 120–21, 129, 201
Interstate Cotton-seed Crushers' Association, 87
Italy, imports of cottonseed oil of, 15–16

Jenkins, Edward H., 61

Kunstspeisefelt, 157–59

Lamborn, L. L., 13, 18
Labeling: designations used, 2, 23, 46–47, 116; early legislation on, 40–45, 48–54; inaccurate and misleading, of compounds, 31; of lard compounds, 23, 46, 72–73; under Meat Inspection Act, 89; provisions on, Food and Drugs Act, 58, 90; state legislation on lard, 60; *see* Appendix D
Lard: in compound, 119; "cotton-oil lard," 25; Cuba lard, 13; as domestic food fat, 166, 204–05; labeling, early legislation on, 40–45, 47 n.; leaf, 8–9; modified, to take on characteristics of compound, 209–10; in the national economy, 214–16; neutral, 10; preference for, as cooking fat, 159, 176; prime steam, 10; refined, 23, 46, 60, 61–62, 209, 211; "salt-trimmings lard," 211; as a shortening, 5, 6, 280, 281, 282–83; variety of products sold as, in 'nineties, 59
Lard stearin, as hardener for steam lard, 9, 11
Lard substitutes, classes of manufacturers, 138–39; quantity and value of, marketed, 196
Lardine (Lardene), exports of, 97
Licensing system: for cottonseed products, during the war, 110–11, 112; United States Food Administration, special regulations for, 308–09, 312–13

McCaw, Wallace E., 74, 75, 93; *see* Appendix D
McClammy bills, 49–50, 51, 53
McGeogh Case, 37–40
Magnolia Provision Company, 149

Manufacture: of compound, costs of, compared to other food industries, 146–48; compound, early progress in the United States, 263–64; lard, early history of, 244–47; of modified lard, 209–10; *see* Production

Margarine: early legislation against, 35, 42; early patents for, 26; the European product, 158; influence of, on exports of compound to Europe, 103; influence on development of compound industry, 10–13, 21, 261; ingredients used in, 11–12, 18, 21, 120–21, 127–28, 129, 201; in the national economy of Denmark, 213–14; as a shortening, 282

Marine oils: in compound, 116–17, 119, 123–24, 178; history of use of, 233–34, 249–51, 253; hydrogenation of, 123; imports of whale oil in the United States, 124; tariff on whale oil, 179

Marketing of vegetable compound: first, 94; after 1922, 115, 122; a method to market cottonseed oil, 178; quantity and value of, 196

Markets for compound, 75, 77, 193–97, 202–03, 205

Marshall, George S., 26

Mayonnaise, use of corn oil in, 132

Meat Inspection Act, 62, 86, 88–90, 94, 105, 115

Meat inspection legislation, 55–56

Mexico, as importer of compound, 101, 108

Morris and Company, 88, 149; *see* Appendix D

National Cottonseed Products Association, 219

Netherlands, as importer of compound, 100

Normann (Crosfield) patent, 93, 273

Norway, hydrogenation of marine oils in, 123

"Oak Leaf," 74

Oil, Paint and Drug Reporter, 27, 79, 95

Oilseeds, European imports of, 103

"Oleard," 26

Oleo oil: in compound, 119, 145; control of production, by packers, 86; in margarine industry, 11–12, 21, 120–21, 201

Oleo stock, production of, for margarine industry, 12

Oleomargarine, cost of production of, 148

Oleomargarine Act, 49, 58

Oleostearin: in compound, 2, 85, 94, 119, 120, 121, 142, 201; control of production, by packers, 86–87; duty on, until 1909, 86; in lard, 12, 21

"Olive Butter," 28, 30

Olive oil: in cookery, regional preferences for, 6, 159; in lard substitutes, 28; shortening power of, 280

"Olivene," 28

Packers: as compound manufacturers, 72–75, 80, 81–88, 94, 134, 136–39, 141–44, 149, 165; costs of manufacture to, 147; efforts of, to strengthen lard markets, 207–12; lard marketing practices of, 206–07; as manufacturers of

purely vegetable compound, 140, 142; as refined lard manufacturers, 60, 138; as steam lard manufacturers, 9–10, 12–13
Paddock bills, 54–55, 57–58
Palm kernel oil: duty on, 132; early use of, in Europe, 8; imports of, 132; price of, 131; probable future use of, in compound, in United States, 131; United States Food Administration special license regulations on, 308–09; use in Germany, in compound, 157; use in Germany, in margarine, 131
Palm oil: early use of, 253–54; United States Food Administration special license regulations on, 308–09; use of, in compound, 125, 130; use, in tinplate and soap manufacture, 130
Patents, *see* Trade marks and patents
Peanut oil: duties on, 126; effect of tariff on, 165, 179; imports of, 126; United States Food Administration reports and regulations on, 308–09; use of, in compound, 125
Philippines, as importer of compound, 101; as source of coconut oil, 165–66
"Plantene," 74, 93
Portsmouth Cotton Oil Refining Corporation, 149; *see* Appendix D
Prices:
  coconut oil, comparison to cottonseed oil, 127
  compound; around and after 1900, 77; behavior of, 196–99; effect of tariff on, 165; export, to 1914, 99; from 1908–09 to 1932, 109; as percentage of lard, 172; relation to cottonseed oil, 174; relationship to lard, 199–203, 218; seasonal variations in, 183–84; spreads of, from lard, long-time trend, 172; wholesale, and index of business activity, 68, 92, 113
  cottonseed oil; behavior of, 197–99; compared to coconut oil, 127; determination of, 173–74; fixed, during the war, 110; independence of, over lard, 94–96; relation to lard, 69, 72, 78, 80, 91–92, 95, 121, 171–72, 198–200; seasonal variation of, 184; spreads between lard and, 172, 180; wholesale, and index of business activity, 17, 18, 68, 78, 92, 113
  lard; behavior of, 197–99; effect of tariff on, 163; effect of United States, on world, 161, 215; export, to 1914, 99; export, from 1908–09 to 1932, 109, 170–71; influence of, on cooking-fat field, 201; post-war, 202; relation to cottonseed oil, 69–72, 78–79, 91–92, 95, 121, 172, 198, 200; relationship to compound, 68–69, 79–80, 171, 179, 200–202, 218; relationship to price of live hogs, 173; seasonal variations in, 183–84; spread between cottonseed oil and, 180; wholesale, and index of business activity, 17, 18–19, 68, 78, 92, 113

oleostearin; control of, by packers, 87; follows major movements of lard, 198–99; post-war, 201; in recent years, 120, 129–30, 212; wholesale, and index of business activity, 68, 92, 113
palm-kernel oil, 131
Procter and Gamble Company, 75, 93, 94, 149, 267, 273; *see* Appendix D
Producers, compound, 149; *see* Appendix D
Production:
compound; from animal and vegetable fats and oils, 194; by class of producers, 149–50; course of, 63–67, 79, 169; decline in, 92–93; during the war, 110; in early 'nineties, 76–77; European, 156–59; by federally inspected and other plants, 62, 90–91, 107, 135–39; forecasting of, 178; post-war, 112, 169–70; of purely vegetable products, 139–41, 174, 194; by regions and states, 143, 150–53; relationship to cottonseed oil, 168–70, 177, 179, 180; relationship to lard, 176, 179, 180; seasonal variations in, 168, 181–83; volume of, 106–08, 142–43; year-to-year variations, factors in, 168–80
cottonseed oil; Aspegren estimates of, 63–64; course of, 169; by class of producers, 149; decline in, 177; early, 14, 16–17, 43, 78; effect of AAA reduction of acreage on, 133–34; post-war, 114, 121, 169–70; seasonal variations in, 168, 181
hard fats, history of, 233–48
illuminating oils, 248–51
lard; difficulties of reducing, 216–17; during the war, 114, 170; early figures on, 32–33, 66–67; from 1900–1932, 171; percentage of, to hog products, 174 n.; post-war, 114, 170; relation to size of corn crop, and other factors, 174–75; seasonal variation in, 181–83
lard substitutes, 140
margarine, post-war, 120, 129
shortening; by classes of manufacturers, 135–39, 150; seasonal variations in, 183
tallow, factors in, 2
"Purola," 27, 30

Read, Samuel, 97; *see* Appendix D
Refiners, lard: disappearance of independents, 24–25, 80; early history of, 9–10, 12; use of cottonseed oil by, 22
Refining, of oils, history of, 251–53
Refrigeration, effect of improved, on compound industry, 36–37
Rendering, steam, introduction of, 8–9

Salad oils, use of corn oil in, 132; use of cottonseed oil in, 18, 19
Schwarzschild and Sulzberger Company, 73; *see* Appendix D
Sears, Joseph, 20
Sesame oil, use of, in compound, 125, 130, 131, 145

Sesame seed, imports of, 131
Shea butter, 179
Shortening: choice of, 281–83; coconut oil in, 128, 277; correlation of flour quality and effect of, 278; early trade marks and patents on, 73–75; effect of, on leavening process, 279; effect of, on onset of staleness, 279; lard as, 5, 6, 117, 205–06, 280, 281, 282–83; margarine as, 282; measurement of, 280–81; method of action of, 277–78; properties of greatest importance in fats and oils for, 276–77; regional preferences for, 5–8; regulations on, for consumer, during the war, 111; use of, by commercial baker, 191, 266; use of, by domestic consumer, 205, 207; use of margarine in Europe as, 103; uses of fats and oils for, 4–5; vegetable compound as, 281, 283
Shortening power: of compound, 280, 281; of corn oil, 280; of cottonseed oil, 280–81, 283; definition of, 275–76; of olive oil, 280; of soy bean oil, 280
"Silverleaf," 73
"Snow White," 29
"Snowdrift," 78
South America, as importer of compound, 101, 159
Southern Cotton Oil Company, 28, 30, 80, 81, 83, 94, 113, 149, 154; *see* Appendix D
Soy bean oil: in compound, 125–26, 130; duties on, 126; effect of tariff on price of, 165, 179; imports of, 126; shortening power of, 280; United States Food Administration special license regulations for, 308–09
Squire, John P., 41
Staleness, effect of shortenings on onset of, 279
Standard Butter Company, 27
Statistical tables, 314–50; *see also* Table of Contents
Stearin, *see* Coconut stearin, Lard stearin, Oleostearin, Tallow stearin
"Suetine," 73
Sunflower oil, use of, in compound, 130
"Supreme Shortening," 73
Swift and Company, 73, 88, 149; *see* Appendix D

Tallow oil, 11
Tallow stearin, 11, 21
Tallows: in compounds, 2, 85, 119–20, 121, 142, 145; as cooking fat, in South America, 159; history of early commercial use of, 234–44; use, in food and industry, 11; use, in lard, 9, 11, 21
Tariffs: agitation for, on Philippine oil imports, 166; on compound, 126, 160, 165, 166; on crude and refined coconut oil, 165; effect on ingredients of compound, 165; influence on price level of fats and oils, 163; in Germany, on fats, 159; on lard, 160, 166, 218; on oleostearin, 86; on palm kernel oil, 132; on peanut and soy bean oils, 126, 179; on vegetable oils, 161–62; on whale oil, 179
Taxing, of compound, 42, 218–20; effect on world prices, 220; of lard substitutes, 218–19

Taylor, Alonzo E., 86, 185
Tompkins, D. A., 19
Trade marks and patents, 25–30, 72–75, 93, 197, 267; of compounded cooking fats registered in United States patent office, to 1930, 284–305; *see* Appendix B
Types of compounds, 1, 114–17, 141; early forms, in Europe, 259–63

Union Oil Company, 19

Vacuum process, for compound, 77, 78
"Vegetole," 73
"Victoria," 29

Wesson, Dr. David, 73, 77, 256, 259, 267
Wesson Process Company, 78
West Indies, as importer of compound, 101; as importer of lard, 102
White grease, 45, 51
Wilcox, W. J., and Company, 24, 149; *see* Appendix D
Wiley, Dr. Harvey W., 47
Wilson bill, 54, 57
Wright, James, and Company, 38

Zapoleon, L. B., 39, 41, 160–66, 185